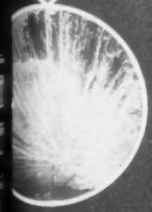
Read Diamonds Synthesized

CHEMISTRY



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True Diamonds

ALMOST everyone remembers that diamonds were made by Moissan in the late years of the last century. Few raise the question why, if his methods were successful, the synthesis of diamonds has not been duplicated industrially.

The fact is that, as a result of better understanding of fundamental processes, we can now look back through the perspective of half a century and find out what was wrong with Moissan's diamonds. He did not use enough heat, he did not use enough pressure, and he "got himself out too far on a limb."

Climaxing an era of excitement during which discovery of diamonds in meteorites seemed to give a clue to how they are formed in nature, Moissan believed he had found the recipe for diamond manufacture. He proceeded to demonstrate their formation in the electric furnace he had just invented. His lectures and demonstrations were apparently successful. But after Moissan's death there were confessions that natural diamonds had found their way into his melts in a face-saving gesture that should never have become necessary.

Whether Moissan was too good a showman or the dupe of well-meaning friends, the problem of making carbon crystallize the right way to produce diamonds has continued to intrigue scientists' imaginations. In the meantime the principles of thermodynamics and the phase rule, still in the stratosphere of abstract theory in Moissan's time, have become guideposts for practical chemistry. A number of modern scientists have explored the territory which is mapped by plotting temperature and pressure on graph paper.

Dr. Percy W. Bridgman of Harvard within the past decade adapted means of creating great pressures to an apparatus which would not break down when such pressure is applied. With the resources of a great industrial plant at its disposal, General Electric Co. has now progressed beyond Dr. Bridgman's pioneer work and combined such pressure with a means of continuous high heat. This further step has achieved crops of man-made diamonds. The boundaries of diamond-land have begun to be sketched out.

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▸ LARGEST DIAMOND *so far to come from General Electric Co.'s huge press is shown here beside the diamond point of a standard high-fidelity phonograph needle. The man-made diamond crystal shown in enlargement here is 1/16 inch long, clear and colorless.*

Real Diamonds Synthesized

by HELEN M. DAVIS

▸ THE WORLD'S costliest diamonds, which may yet turn out to be a great bargain, have been synthesized at Schenectady, N. Y., by a research team of the General Electric Research Laboratory. This is apparently the first time in history that diamonds have been made by man.

Numerous attempts to make diamonds have occurred during the past century. In the October 1948 issue,

CHEMISTRY reviewed the history of these attempts and described the belief current at that time that thermodynamic theory might forbid diamond making under earthly conditions. The thermodynamic theory still holds, but scientists have stretched the conditions to accomplish what once seemed impossible.

Diamonds are pure crystals of the element carbon. They are enormously harder than any other substance known. Their hardness is the unique quality which makes them valuable industrially for cutting edges and abrasive powder. It is even a factor in their value as gems, since they are in some ways almost indestructible, and can be scratched only by another diamond.

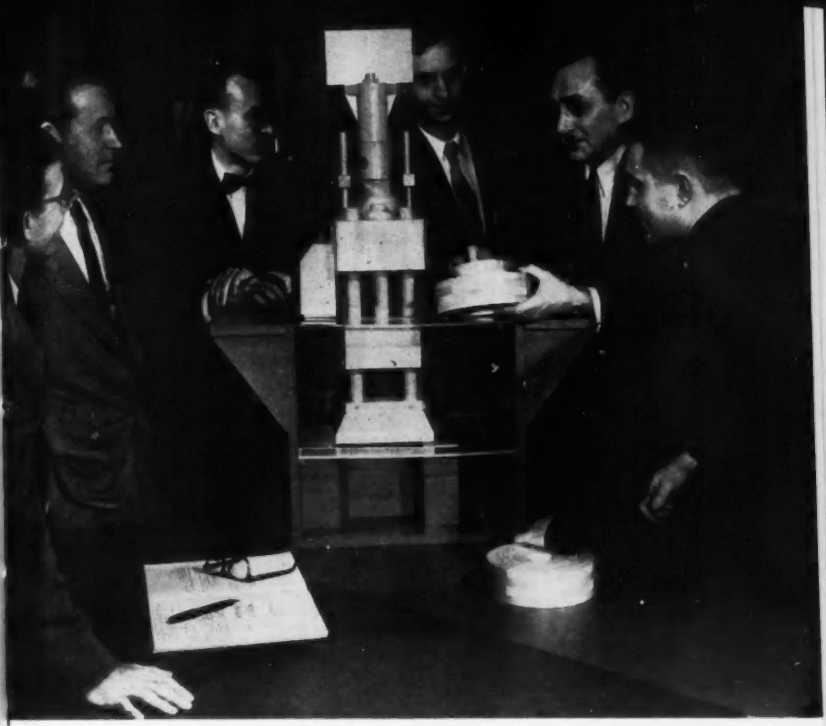
Success in manufacturing diamond crystals so hard that they scratch other diamonds was demonstrated in February, 1955, by research scientists of the General Electric Co., Drs. Francis P. Bundy, H. Tracy Hall, Herbert M. Strong and Robert Wentorf.

Combining enormous pressure, 800,000 pounds or 400 tons per square inch, with a reaction chamber which can be heated to more than 5,000 degrees Fahrenheit, the G.E. scientists have so mastered the conditions under which diamonds form that they have been able to produce these, the hardest crystals in nature, in more than one way, out of more than one material. Diamonds have been made every time, in more than 100 runs.

The new man-made crystals pass the same X-ray test that is used to assay natural diamonds. Their hardness is greater than that of any other material. Some of the new crystals have been burned to carbon dioxide, to prove that they are really crystalline carbon. They easily scratch sapphire, silicon carbide and boron carbide as well as natural diamonds.

Diamonds have been found in meteorites. These heavenly missiles are believed to be fragments of an ancient planet which exploded, perhaps about the time our earth was formed. Study of the way these naturally occurring diamond crystals are found always imbedded in iron meteorites, never in stony ones, led the General Electric Co. scientists to select the temperatures, pressures and surroundings which proved successful for production of diamonds. Iron meteorites would have come from the center of the exploded planet, and have been subjected to heat and pressure similar to conditions calculated to exist some 240 miles below the surface of the earth.

Greatest obstacle to making diamonds according to calculations based on these theories was the development of a press capable of producing such pressure in a container which could be heated and held at the high temperature necessary for rearrangement of the carbon atoms into the diamond's crystalline lattice form. Chief problem in development of such a press was creation of a material for the container which would keep its contents intact during the time the pressure acts. Both these problems have been solved by the diamond-makers. The clusters of very small diamonds they have made were crystallized in a few minutes. To make the largest so far produced, the melt was held under constant conditions at a high temperature for 16 hours.



SIX MEN *who have made diamonds are, left to right, Drs. Francis P. Bundy, Herbert M. Strong, H. Tracy Hall, Robert H. Wentorf, Anthony J. Nerad and H. E. Cheney. They have successfully turned out synthetic diamonds in more than 100 runs, sometimes getting solid clusters of the crystals, weighing up to 1/10th carat.*

Earlier attempts to make diamonds in the laboratory have usually started with the element carbon in the form of graphite. The French chemist, Henri Moissan, who created great excitement by his claim to have made diamonds in 1894, used carbon in solution in molten iron. Scientists at the General Electric laboratories start with carbonaceous compounds. They have produced crystals of various colors, such as are found in the jewels produced in nature. The man-made crystals are up to 1/16th inch in length.

Jewelers would not scorn some of the artificially produced diamonds. They would pronounce them genuine. However, laboratory-made diamonds are not expected to invade the jewelry market. Industrial diamonds, the so-called "black diamonds," offer a more useful outlet if the General Electric Company should wish to put its dia-

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mond-making technique on a production basis. Cutting with diamond-studded drills and polishing with diamond dust are technical processes always in need of the super-hard carbon crystals.

The first artificial diamonds were made in 1954. Discovery that diamonds actually were made came when the core of super-hard matter from the pressure chamber wore away the polishing wheel.

There is some doubt whether extreme heat must always be used with the high pressure to make diamonds. All previous experiments with high heat, although with less pressure, gave graphite instead of diamond. Measurements of free energy changes in carbon had suggested that intense cold such as found in outer space might aid in bringing about the change from graphite to diamond.

The giant press used in diamond production is capable of 1,500,000 pounds per square inch pressure, which is roughly equivalent to the squeeze computed for points 240 miles beneath the earth's surface. This equipment makes small diamonds in a matter of minutes.

The G.E. scientists bowed to Dr. Percy Bridgman of Harvard University whose discoveries in measuring extreme pressures were used in the diamond production.

The method of applying pressure in G.E.'s giant press is similar to that pioneered by Dr. Bridgman. The further step taken by the General Electric team was in adding the heating device. The energy added to the system by heating turned the trick of shaking the carbon atoms out of their common arrangement into the special one which makes diamonds. Dr. Bridgman's experiments developed great pressure, but at room temperature. His pressures actually carried his material well into the theoretical range of conditions where diamond production is possible.

Many further experiments, both with diamond-making materials and with other substances are planned by the General Electric Research Laboratory. They will include attempts to make diamonds out of organic compounds of carbon. Other elements will be subjected to the extreme conditions made possible by the new apparatus, which effectively doub'es the field of experimental conditions available for study.

Most elements change their physical state dramatically when conditions of temperature and pressure change. The familiar states of solid, liquid and gas result from such variations in conditions, but a number of differences in crystalline state also appear when solid materials are subjected to changes in conditions. There is, in addition, the strange state encountered near absolute zero in which certain materials lose their electrical resistance and others seem to ignore gravity.

Carbon as an element has its own peculiarities. Ordinarily it exists in either of the two crystalline states, graphite or diamond, whose properties are almost exactly opposite from each other. At high pressures, carbon changes directly from the solid to the gaseous state. As a gas it can be identified by its spectrum in the sun and in some other stars. Under conditions man can produce on earth the three

▸ DIFFRACTION PATTERNS *which appear when X-rays are turned on diamonds show that the crystal structure of natural diamonds and General Electric Co.'s new man-made diamonds is the same. Patterns of dots on the left are made when single crystals are used. Ring-shaped patterns on the right result from using diamond dust.*

phases, graphite, diamond and gas, are almost sure to be the only forms of carbon. But a French experimenter, Basset, has recently found that, at high pressures combined with extremely high temperatures, carbon will appear in the form of a liquid.

Liquid carbon will be among the substances General Electric scientists will use their new apparatus to find out about.

Shifts of phase, as from one crystalline form to another, are usually accompanied by some change in energy. Sometimes this appears as motion, so that some of the crystals will push others away, and cracks will appear. Such rearrangements often are to blame for failure of metals, as in aircraft under unusual conditions. Always some of the energy appears as heat. Some phase changes give off heat

when they take place in one direction, but have to have heat supplied to them to go in the other direction.

Shift of solid phase from graphite to diamond seems to be one of the changes requiring an extra supply of energy. A General Electric Co. scientist drew an analogy to explain this by comparison with gravity. A person on an upper floor of a building is acted upon by a force of gravity sufficient to make him fall to earth, but this is prevented by the floor which holds him up. To use the force of gravity, he must add the energy to climb out of the window or cut a hole in the floor. The natural stability of carbon will keep a "floor" under graphite at pressures well up into the range where diamond can form. The heat supplied in the new process adds the extra energy to effect the change-over. But unless the system is in the region where diamond is a possible phase any change over is impossible. Further mapping of the boundaries of these phases is now possible with General Electric's apparatus.

On the Back Cover

➤ DIAMOND-MAKING *press in the Research Laboratory of General Electric Co. in Schenectady, where heat and great pressure change other forms of carbon to diamond crystals. The pressure reached here can become as great as 100,000 atmospheres, or 1.6 million pounds per square inch.*

Radio Transmitter in 20mm Shell

➤ A RADIO transmitter about the size of the first joint of your ring finger has been developed by the Navy. Not only is it smaller than a wrist radio, but it is shock proof too, and works even after being shot out of a cannon.

The purpose of the tiny unit, called a spin sonde, is to trace the rotation of 20 millimeter projectiles as they speed toward their targets. The device which fits inside the warhead is powered by a mercury battery with a life of 200 hours and uses transistors instead of radio tubes. It is believed to be the smallest ever developed.

As the transmitter rotates along with the projectile in flight it sends out radio messages that are picked up and recorded by an oscilloscope on the ground. The device was built to withstand shocks 30,000 times the force of gravity. It can be used over and over again since ordinarily it can withstand the shock of hitting the test target.

The transmitter was designed by Roy J. Smollett of the Technical Evaluation Department of the Naval Ordnance Laboratory.

Proton Polarized, Important As Polarization of Light

New Nuclear Particle Events

➤ An achievement equivalent to the discovery of polarization of light in optics is exciting interest in the field of atomic physics. For the proton has been polarized.

This means that hearts of hydrogen atoms have been produced that all spin the same, much as visible light that vibrates in the same direction is said to be polarized.

A new push of research using proton polarization is under way at the University of California at Berkeley, the University of Chicago, the University of Rochester and Carnegie Institute of Technology.

What happens when proton meets proton is being explored. Results were reported at the Berkeley meeting of the American Physical Society.

A team from the University of California, consisting of Drs. Emilio Segre, Thomas Ypsilantis, Owen Chamberlain, C. Wiegand and R. Tripp, flung hydrogen under a 310,000,000 electron-volt impulse against beryllium metal to polarize the protons. The way the protons act is measured by further scattering from targets.

Experiments on proton polarization were reported also by Dr. R. B. Sutton of Carnegie Institute of Technology and Mrs. Leona Marshall of the University of Chicago. The proton is one of the most fundamental of the atomic particles.

Other highlights of scientific reports presented to the American Physical Society included:

Certain red giant stars with temperatures of over 100,000,000 degrees F. are stoked by the direct conversion of three alpha particles, which are the hearts of helium atoms, into carbon 12, with beryllium as an intermediate step. Dr. E. E. Salpeter of Cornell University, Ithaca, N. Y., reported his calculations for the rate of this reaction, which depends on the temperature and density of the star.

Dr. S. F. Singer of Maryland University suggested that cosmic rays smashing into the earth's atmosphere from space may result from the break-up in interstellar space of radiation consisting mostly of iron.

A "meson-generator" can increase by a factor of five the number of cosmic ray particles, known as K-mesons, stopped in the stripped photographic emulsions flown at high altitudes to catch tracks of atomic fragments. The emulsions are put inside an iron and paraffin block to get the increase, Drs. N. Seeman, M. M. Shapiro and B. Stiller of the Naval Research Laboratory in Washington reported.

Polarized Radio Signals

➤ Polarized radio signals are being tested as a method of long-distance communication in the zone of the aurora, or northern lights.

Changes in the earth's electrical "roof," or ionosphere, at times serious-

ly hamper radio transmission around the world. In the far North, however, auroral activity is an added major cause of radio fading and poor reception.

Polarization of radio waves may be a solution to one or both of these problems, experts at the Thayer School of Engineering of Dartmouth College, Hanover, N. H., believe. A team headed by Dr. Millett G. Morgan, director of research at the school, has devised special equipment by which the radio engineers can maintain consistent reflections of radio waves from the ionosphere for relatively long periods of time.

Their research is supported by the U. S. Navy. The Dartmouth experts worked out their method by sending radio waves straight up to the ionosphere, then observing the echoes from the various ionospheric layers on a television-like tube.

Now they have started on a series of long distance transmissions between Hanover and special equipment installed at McGill University Sub-Arctic Research Laboratory at Knob Lake in Labrador and at the University of Saskatchewan in Saskatoon.

The Knob Lake installation is designed to test how effectively the new-type signal may be transmitted through the aurora. Knob Lake is 900 miles north of Hanover, thus much of the region of greatest auroral activity lies between the two points.

Polarized radio waves may also be a solution to the problem caused by "SID's," or sudden ionospheric disturbances, when the sun may hurl out a great tongue or flame from which hydrogen atoms bombard the earth about 20 hours later. Shortwave radio can then be blacked out for periods ranging from a few seconds to several hours.

Dr. Morgan and his associates are also working on equipment for adjusting the polarized radio signals automatically to changes in the ionosphere from moment to moment.

Radio Absorption Lines

➤ RADIO WAVES being broadcast by heavenly sources show absorption lines just as light from the stars does. Astronomers around the world are excitedly discussing this discovery, which opens up a new era in astronomical research.

Discovery of these absorption lines in radio waves from otherwise invisible points in the sky gives astronomers another yardstick for measuring distances within the Milky Way galaxy in which the sun is but one of hundreds of millions of stars.

It also tells them about the amount and distribution of the hydrogen gas filling the space between the stars.

Drs. John P. Hagen and Edward F. McClain of the Naval Research Laboratory, Washington, D. C., were the first to spot the absorption lines in radio waves of 21 centimeters, or about eight inches. Dr. A. Edward Lilley and Miss Nannielou Hepburn, also of the Naval Research Laboratory, have now joined them in an intensive search for other sources showing the same absorption lines.

From their studies so far, Dr. Hagen and his associates have concluded that interstellar hydrogen is probably distributed in clouds in interstellar space, rather than continuously as has been thought.

These hydrogen clouds have diameters of several parsecs, one parsec being the distance that light travels in 3.26 years. Within such clouds, the hydrogen atoms are comparatively dense for interstellar space, 100 per cubic centimeter compared to the one per cubic centimeter assumed for uniform distribution of the hydrogen.

The radio wave absorption lines result when such hydrogen clouds come between the relatively bright background of a heavenly radio source that is broadcasting at a wavelength of 21 centimeters. The clouds, which also radiate on their own at 21 centimeters, cut out that particular wavelength when they are between the earth and the bright radio source.

This is absorption and is familiar to optical astronomers who work with light waves. It is caused by atoms and molecules taking up, or absorbing, the energy of a source whose temperature is higher. Just as flames or stars emit light waves, so also do radio antennas or certain heavenly sources send out radio waves.

These radio sources have a "temperature," or energy level as visible stars do. When the temperatures of such sources are considerably higher than the estimated 120 degrees Kelvin of interstellar hydrogen, the resulting absorption can be detected by delicate electronic instruments.

So far, only three radio "stars" showing absorption lines have been discovered, although the Naval Research group searches daily for others.

Matter From Energy

▸ THE MOST powerful atom smasher in the world, the University of California's bevatron, is transforming energy into matter at the highest man-made energies ever produced.

Hurling protons at nearly the speed of light, physicists reproduced in the bevatron the disintegration of atomic particles previously known only from cosmic rays bombarding the earth from space. The tremendously high energy reported to the Fifth Annual Conference on High Energy Nuclear Physics by Dr. H. M. Powell and coworkers was that of a 4,000,000,000-electron volt pi meson smashing directly into a proton. Four chunks of mesic matter and a proton resulted. Some of the energy of the bombarding nuclear particle was transformed into mesons.

Scientists are reaching higher and higher energies in atom smashing experiments. Their aim is to understand the forces which keep an atomic nucleus from flying apart. Mesons carry the nuclear force fields.

Another tool for investigating these forces was reported by Dr. Emilio Segre and his associates, also of the University of California. They have passed proton beams through two hydrogen filled chambers to get atoms whose spins are all in the same direction. Then the beam is passed through a carbon target. The resulting nuclear particles are analyzed with a scintillation counter.

Physicists call this a triple scattering, since protons in the original beam are bounced from three targets.

The University of California group is the first to perform triple scattering experiments, but this has been done so recently that results are still being analyzed.

21 Inhabitants of Atomic Core

➤ LOOKING into the crowded cores of atoms, scientists are beginning to recognize some familiar faces.

Dr. J. Robert Oppenheimer, director of the Institute for Advanced Study, Princeton, N. J., said 21 inhabitants of the core or nucleus, some of which exist only for fleeting bits of seconds, are listed now in the scientific census.

Some, such as the neutron which triggers the A-bomb, have long been known. Two new ones, the K mu-two and the K pi-two, received their birth certificates at a nuclear physics conference recently, said Dr. Bruno Rossi of Massachusetts Institute of Technology.

So elusive are these queer particles that ten laboratories had to pool their information to pin them down. They have been glimpsed only 21 times.

Summing up advances in physics during the past year, Dr. Oppenheimer said it was "very striking" that physicists are not asking the same questions now as a year ago about the inner cores of atoms. Observations and calculations have settled a few of the questions.

But exactly what is going on in the nucleus is still a puzzle. Strange particles, not predicted by any theory, come whizzing forth, are seen for billionths of a second, then change their faces.

To pool their knowledge of these odd events, over 100 top nuclear physicists from the United States and abroad met at the University of Rochester. Reported at this meeting, the Fifth Annual Conference on High Energy Nuclear Physics, was a definite value for the effective size, or hardcore, of the proton, the heart of the hydrogen atom.

It is seven times ten to the minus 14 centimeters. This is scientific shorthand for saying that a proton is 3 hundred-million-millionths of an inch. High energy electrons were used by Stanford University physicists, led by Dr. R. Hofstadter, to probe the proton structure for this measurement.

Dr. Oppenheimer said that discovery of "clusters of masses"—"faces" in the nucleus with some features alike and others different—was one of the most important reports.

The "hot brother" theory, associated production of particles in pairs, seems to be confirmed in cosmic ray experiments. The associated production was predicted by theorists before it was actually discovered, Dr. Oppenheimer said.

Dr. Robert Bacher of California Institute of Technology and Dr. Robert E. Marshak of the University of Rochester joined Drs. Oppenheimer and Rossi in describing the present state of nuclear physics.

New Tantalum Isotope Found

➤ A NEW, naturally occurring isotope of tantalum, known as Ta 180, has been discovered with the aid of a mass spectrometer by Drs. F. A. White, T. L. Collins and F. M. Rourke of General Electric's Knolls Atomic Power Laboratory.

Atomic Waste Better Than Radium Itself

Atomic Reaction Materials

➤ How MAN is learning to live in a more radioactive world is revealed in the 17th semi-annual report of the Atomic Energy Commission.

Fission products which have accumulated in large quantities from atomic reactors have been put to work supplying small portable and potentially deadly sources of radioactive rays which will perform such different services as treating cancer and keeping potatoes from sprouting.

Cesium, an element rarer than gold and known chiefly from analysis of the water from mineral springs, is separated from the fission products for use of the rays it gives off. It is packaged as a disc the size of a fifty-cent piece and about as thick as a woman's powder compact. The case is of stainless steel, made double to protect against leakage of the salt-like contents. This small package holds the equivalent in treatment power of radium which would be worth $20,000,000 if there were that much radium in the world.

Other rare elements available from atomic processes, which have been known before only in trace amounts, include gadolinium, europium, and dysprosium. These have found uses, because their oxides glow when heated, resembling lime in "lime-light" quality. They are used as cores in searchlight carbons and motion picture projectors. They also combine with glass used in sunglasses to give protective tints, and to give special properties to camera lenses.

For detection of dangerous quantities of radiation, two new instruments have been devised. One is a scintillation counter large enough to surround a person, so that the entire amount of radioactivity in his body is made visible at one time. New chemicals which will shine when irradiated have been developed for use with this counter, so that a total of 77 satisfactory ones are now known.

The other new instrument is a gas-filled counter containing helium with or without nitrogen which works at high speeds which would be too much for conventional counters.

Effect of radiations on plastics is shown to be of two kinds. Nylon proves to be strengthened like polyethylene, due to "cross-linking" which the radioactive rays promote, but plastics similar to dacron are weakened by such treatment. Heavy doses of radiation, however, harm all plastics, the report states.

A new building at Oak Ridge, Tenn., will be built soon to separate and purify fission products for these and other uses. It will expand the "hot chemistry" facilities and serve as a pilot plant for industrial installations.

Rare Element For Reactors

➤ TECHNETIUM now joins zirconium as material for building atomic reactors.

Ability of technetium to soak up slow neutrons is revealed in the Atomic Energy Commission's 17th semi-annual report. This ability is an important new kind of information for designers of nuclear fission machinery, important because these materials themselves may take part in the radioactive disintegrations going on inside the reactor. Technetium appears to be like graphite, boron, cadmium and zirconium in absorbing neutrons harmlessly.

Technetium is a "ghost" element, made in atomic reactors and occurring in fairly large quantities among the fission products. It does not occur in appreciable quantities anywhere else on earth, but is found in certain kinds of stars. All 15 forms of the element so far detected are radioactive. The half life of the most stable among its 15 isotopes is about 10,000 years.

If the element once existed in quantity on earth, it must have vanished by transmutation into some other element. The fission process recreates the vanished element. Chemists are interested to find that it is silvery in color and that its compounds are similar to those of manganese, a metal used in the manufacture of special tool steel.

Unique Uranium Specimen

➤ A SPECIMEN of uranium weighing 103 pounds and assaying better than 80% has been put on exhibit at the American Museum of Natural History in New York City.

A gift of Vernon J. Pick, the uranium prospector who "struck it rich," the specimen was described as one of the largest pieces of super-grade uranium ore ever mined.

"It is the finest specimen of its kind in any museum, for its size, for its richness in uranium and for the interesting association of pitchblende and its yellow alteration parts," said Dr. Brian H. Mason, the Museum's curator of physical geology and mineralogy.

Worth about $1,000 as uranium ore, the specimen has a 24-inch circumference and is 19 inches long. It is colored a brilliant orange and yellow, with black spots.

Mr. Pick mined the atomic-age find from the Delta Mine near Hanksville, Utah.

Road Paved With Uranium

➤ A ROAD on the outskirts of Carcoar, in western New South Wales, is paved with uranium.

So are the bush tracks leading to the town's long disused iron ore shafts.

Tests conducted by the New South Wales Government's Department of Mines revealed that the iron-ore shafts are rich with uranium, and that the horseshoe of hills ringing the town also contain large deposits.

Soon after the announcement of the "strike," shearers, station hands, farmers and graziers poured into the town on foot, push-bike, horseback and in cars.

An oldtime resident, Roy Furner, 53 years old, remembered that mullock from one of the old shafts had been used to surface the Mount Road and bush tracks.

Mr. Furner's memory was proved right, when prospectors found the roads were literally paved with uranium-bearing ore.

Atomic Explosions Have No Effect on Weather

Weather Ignores Dust and Debris

A-BOMB explosions do not affect the weather by any test Weather Bureau scientists have been able to make.

Dr. Lester Machta and D. Lee Harris of the U. S. Weather Bureau have investigated possible ways that A-bomb tests might affect weather.

There appears to be no reason for believing that any past explosion at the Nevada Proving Ground has had any significant effect on the weather more than a few miles from the test site, they concluded.

Every year since the atomic weapons testing program was enlarged in 1951 both the Weather Bureau and the Atomic Energy Commission have been besieged by letters blaming unpleasant weather on the tests. Their analysis does not support this charge.

The possible relationships of A-bomb test and weather investigated included effects of atomic debris as cloud-seeding nuclei, on atmospheric electricity, on solar radiation, on climate and on the energy level of the atmosphere.

They found no reason for believing that any of the mechanisms examined was responsible for weather changes.

Dr. Machta and Mr. Harris concluded that the year 1953 was an unusual tornado year, but they attributed this to improvements in tornado-reporting methods.

A study of the temperature and precipitation records for the U. S., they said, does not seem to indicate any departures from normal that are related to the atomic explosions.

Most theories suggest that A-bomb tests would increase rainfall. The U. S. now seems to be going through a dry spell, which began in 1952, the driest year since 1930. The years 1910 and 1921, as well as 1930, were drier than 1952, the meteorologists pointed out, and atomic explosions could not have caused them.

Temperatures in the U. S. have tended to be warmer than normal since 1951, the scientists said, but noted that if atomic debris cut down solar radiation, it should mean lower, not higher temperatures. The trend toward warmer temperatures was even more pronounced during the period 1932 to 1934, long before the atomic bomb.

The cloud-seeding effects of atomic debris were investigated to see if radioactive particles might serve as ice nuclei and by testing the soil thrown into the air to see if it was effective in forming precipitation. Results in both cases were negative.

Concerning possible electrical effects, Dr. Machta and Mr. Harris concluded that no observational evidence or theoretical reasons have been found for believing that changes in the electric conductivity of the air will lead to any directly observable changes in the weather other than the possibility of decreasing the amount of lightning.

Although large amounts of dust in the atmosphere are known to reduce solar radiation received on the ground, as occurred after the eruption of Krakatoa volcano in 1883, the amount of dust thrown out by atomic explosions is considerably less than that required to produce a noticeable effect, the Weather Bureau scientists said.

The energy of the explosion itself also has no effect on the weather, the meteorologists concluded, noting that the energy of a nominal A-bomb is equivalent to 20,000 tons of TNT, while the energy released by water condensation in a typical thunderstorm is 13 times this amount.

Further comparisons with natural phenomena reveal similar statistics suggesting that the energy of an A-bomb, while tremendous compared with the energy of other man-made explosions, is relatively small compared to that of many natural phenomena, they said.

To make sure that no reasonable explanation concerning the effects of atomic explosions on weather would be overlooked, the Weather Bureau meteorologists asked for suggestions from most organizations in the U. S. that employ scientists.

Of the 80 or so replies received, about half could see no possible connection. The others made suggestions along the lines investigated by Dr. Machta and Mr. Harris.

Although the probability of any change is small, the two scientists noted that there does not seem to be any reason why such modification would necessarily produce worse weather than might occur naturally.

Weather Bureau Rain Report

➤ THE WEATHER BUREAU has made the first public report on its two-year project of seeding clouds over Washington State with dry ice thrown from airplanes to increase rainfall. But Ferguson Hall of the U. S. Weather Bureau in Washington firmly refused to admit either success or failure of the effort until further evaluations have been made.

Because of our limited ability to estimate the rainfall that would have occurred in the seeded area if dry ice had not been used, he said, it is possible that seeding effects could have been produced and still have been hidden by natural variations in rainfall.

None of the evaluations made so far, Mr. Hall pointed out, exclude the possibility that effects as great as a 15% increase in precipitation were produced in the target areas under observation, usually about 100 miles long.

There was, he said, apparently a slight negative effect, with seeded areas getting just a tiny bit less rain than the control areas.

Chance, the perversity of nature in showering so much rain on control areas that it drowned out any real increase due to seeding in the test areas, could give this effect, Mr. Hall noted.

More definite results may be available by summer, when the information has been analyzed further, including possible increases in rainfall of a highly local nature.

The seeding operations were made during the spring of 1953 and from September, 1953, to May, 1954, over

Washington State. Dry ice spread by airplanes was used to insure that the exact location and time of seeding was known. Dry ice is thought to be effective over a wider temperature range than silver iodide, also often used in "rain making."

When suitable cloud formations, usually of the type associated with winter storms, were spotted, an airplane was sent up to make its run. To guard against bias in the test, dry ice was sprinkled only if instructions, contained in a sealed envelope and prepared previously by another government agency, so directed.

Exactly the same measurements were made whether or not the clouds were actually seeded. A total of 60 flights gave 35 with appropriate test conditions. Seeding took place during 22 of these, the other 13 serving as controls.

Rainfall was recorded by 100 gauges located in an area about 100 miles in diameter. Two radar sets were used, one to keep a continuous record of clouds over Hoquiam, on the western Washington coast, and the other to spot rain formed during the seeding operations.

Our survey of clouds, their types and structure, and how many are ripe for seeding, will be one of the most valuable results of this research, Mr. Hall said.

Persons attempting to modify the weather now have to submit monthly reports on their operations to the Advisory Committee on Weather Control for evaluation.

The Weather Control group was set up to recommend to the President and Congress the extent to which the Federal government should experiment with, engage in or regulate attempts to increase precipitation or otherwise affect the weather. It is headed by Capt. Howard T. Orville, retired Naval officer now affiliated with the Friez Instrument Division of Bendix Aviation, Baltimore.

Hand Injury to Plastics Workers

▸ Workers in chemical plants that manufacture plastics face a new health danger, that of seriously damaged hands, Dr. Joseph M. Baker of Springfield, Mass., declared at a recent meeting of the American Society of Plastic and Reconstructive Surgery.

In each of two cases liquid plastic material being forced into a mold was injected accidentally into the palm of the worker's left hand, Dr. Baker reported.

The material immediately solidified, and though it was possible to remove it, it caused extensive damage to muscles and tendons of the hand. Swelling, numbness, intense pain and loss of motion in the fingers were early results of the injuries.

One patient, Dr. Baker said, was hospitalized for 47 days, with further rehabilitation necessary to restore function before he was able to return to work. The other patient, hospitalized 40 days, was returned later to the hospital for skin grafting, and faces future surgery of bone and tendon grafts before hand function is restored.

XUM

Increasing Speeds Crowd Materials Design Limits

Jets For Newer Aviation

➤ FLASHING by at a speed equivalent to 15,000 miles an hour, some nylon balls in an experimental chamber at White Oak, Md., are believed to have attained the highest Mach number ever reached under controlled conditions.

They get hotter than the surface of the sun. They light up the room in which they are fired.

The purpose of the experiment, conducted by the Naval Ordnance Laboratory's Aeroballistics Department, is to study what happens to the gases around a super-sonic missile. Dr. Robert N. Schwartz and Jerry Eckerman found that the gases dissociate when projectiles reach Mach 10, or ten times the speed of sound. This has a cooling effect on the surface of the missile. Thus heat generated in flight does not increase as quickly when such great speeds are reached.

Though the experiment is a pure physics project, the scientists believe that their findings will produce basic information of great use to missile designers. At present, air speeds are limited by the "thermal barrier," the velocity at which projectiles begin to melt. At speeds of Mach 5 or over, all commonly used engineering metals become molten.

Nylon balls are used in the experiments because they are light. Though they are shot from a rifle with a 30 caliber cartridge they reach speeds far greater than the largest artillery shell can attain. The balls are fired through a two-foot tube filled with xenon.

The particles have reached a speed of more than Mach 20, but the scientists achieved this by engaging in a little scientific "cheating."

The balls actually travel at about 7,150 miles an hour, which in air would be about Mach 10. But since they are shot through xenon, and this gas conducts sound a little less than half as fast as air, the balls technically are moving at more than Mach 20, or the equivalent of almost 15,000 miles an hour.

The scientists point out, however, that the balls simulate very closely what would happen if they were actually fired at Mach 20 in air.

Dr. Zaka Slawsky, chief of the hyperballistic division, said that he believed this was the first time that such high Mach numbers have been reached under controlled conditions.

1,000 Miles An Hour

➤ PLANES that fly 1,000 miles an hour will be produced within the next few decades, it was predicted at a meeting of the Society of Automotive Engineers.

At that speed a plane could circle the earth at the equator in one day.

Such planes should be completed "long before 50 years elapse," Dr. Arthur L. Klein, professor of aeronautics at California Institute of Tech-

nology and consultant for Douglas Aircraft Company, Santa Monica, Calif., said.

He also predicted that the helicopter will come into its own within the next half century and that structural metals for aircraft will be at least twice as strong as the ones used today.

The widespread use of helicopters waits only on improvement of reliability and reduction of cost, he said. The problem of safety is far more acute for helicopters than with cars, he pointed out. Mere contact with another helicopter might be fatal.

With the introduction of stronger metals for airplanes, Dr. Klein said, and newer manufacturing and assembly techniques, the aircraft 50 years from today will be as superior to today's best planes as today's aircraft is to those of World War I.

Commercial Jets in 1960

➤ WIDESPREAD use of commercial jets and perhaps some helicopter service for short hops in five years was predicted by the engineering director of Trans-Canada Airlines.

It is unlikely that any new big reciprocating engines will be developed, J. T. Dyment told a meeting of the Society of Automotive Engineers. Most airlines feel that the end of the road in the evolution of this type of aircraft motor has been reached.

Prodded by military contracts, designers will concentrate on jet planes, and as a result commercial jets for transcontinental and transoceanic flights are likely to be available by 1960. Jet engine power has already outdistanced civil requirements. A turboprop plane, the Dart-powered Viscount, is already scheduled for use in Canada.

In five years there also may be commercial helicopters that will pay their way, but Mr. Dyment believes it will take that long.

Manufacturers were called upon to reduce the landing speeds of commercial jet aircraft to below 100 miles an hour. This could be done relatively easily by using the huge quantity of air that flows through the turbine to interfere with the flow of air over the wing.

Mr. Dyment expressed fear that designers would shorten the wings of turbine powered planes to get increased flying speeds, thus making landings even more dangerous.

Jet Engine For Tiny "Gnat"

➤ THE ORPHEUS engine for the tiny British Gnat jet fighter is now being tested and it is even lighter than had been expected.

The first Gnat with the new engine is scheduled to undergo flight tests this summer in England. Development of the light, short-range interceptor is being watched with interest by aircraft designers all over the world. It marks a new trend in fighter development.

United States jets have in general become continually heavier. More instruments, mechanical aids and safety devices have been added to each successive model. Experts point out that for each additional pound of equipment added to a plane sometimes as much as 15 pounds of support structure must also be added.

Some British designers believe that there is an important need for light fighters, especially, they say, since

XUM

some European countries cannot afford to produce the heavy, expensive American models.

The Gnat is said to weigh 6,000 pounds, about one-third as much as the F-86 Sabre Jet, the United States' fighter which accounted so well for itself in Korea. The newer F-100 Super Sabre weighs about 27,000 pounds.

The wingspan of the Gnat is 20 feet 8 inches as opposed to 36 feet for the Super Sabre, and it is only 28 feet 9 inches long while the Super Sabre is 45 feet in length.

The new Bristol Orpheus engine was designed for a 5,000-pound thrust and was originally expected to weigh 850 pounds. The weight of the Orpheus now being tested was not disclosed.

Performance data on the Gnat are not yet available, but it is known that the two-ton Midge, a prototype of the Gnat with one-third its thrust, has already dived through the sound barrier.

"Thrust-Spoiler" For Jets

➤ JET PLANES can now be braked in the air with a new "thrust-spoiler."

The device is expected to shorten the jet landing approach and provide additional safety. In an emergency the pilot can turn off the brake and regain full thrust instantly.

The thrust-spoiler, built by General Electric's Jet Engine Department for the J-47, could also be installed on the giant B-47 Stratojet bomber.

Described as lightweight and easy to maintain, the device deflects the gases before they reach the jet exhaust nozzle, thus reducing the effective thrust while the engine runs at full power.

A newer modification of the deflector that would reverse jet thrusts for an even more powerful braking action is also under development.

Lubricants For Jets

➤ AIR-SUSPENSION or graphite-lubricated bearings may be the answer to the high temperatures of whirling parts in new turbojet planes.

Petroleum oils break down at high temperatures and turbojets are envisioned that would generate heat up to 1,000 degrees F. in the bearing casings.

R. L. Johnson and Edmond E. Bisson of the Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, told the Society of Automotive Engineers that air suspension bearings are not subject to fatigue failure or thermal instability at high temperatures. In fact, they said, air bearings can actually withstand heavier loads at high temperatures. However, a source of high-pressure air is necessary and there is a possibility that thermal distortion will cause harmful misalignment of parts.

Solid lubricants such as graphite and molybdenum sulfide have also proved to be good lubricants at 1,000 degrees F., but the scientists pointed out that their limitations are not yet known.

Thunderjets Truck-Launched

➤ CONVENTIONAL piloted jet fighters have been launched from a truck platform at Edwards Air Force Base, Calif., in world's first flights of such craft without a take-off run.

F-84G Thunderjets with booster bottles attached to their tails swooped

up from the ramp and immediately took flight. The equipment that launches the Air Force's guided missile, the Matador, was used in the tests.

The technique may eliminate the need for runways in certain combat conditions, and also add flexibility to maneuvers because the ramps are mobile.

Test pilot Bob Turner said the shock of the take-off was less than pilots experience during catapult take-offs. The planes were always under control.

The launching technique was developed by the Air Force's Air Research and Development Command and the Glenn L. Martin Co., Baltimore, Md.

Magnesium Fuselage

▶ AN EXPERIMENTAL plane with a magnesium fuselage is undergoing its first tests at Mitchell Air Force Base.

The specially designed F-80C is one of two magnesium-hulled aircraft ordered by the Air Research and Development Command. A previous model was successfully static tested at the command's Wright Air Development Center in Dayton, Ohio.

Engineers explain that the advantages in the use of magnesium, a light metal, are that the substance is probably the best substitute for aluminum and that the supply of the metal is nearly inexhaustible.

The thicker skin structure of the aircraft is expected to cut production and maintenance costs. Designers also point out that it is probably the most efficient light structural material where buckling is the controlling design consideration.

When aluminum became scarce in World War II, progressively more magnesium was used in airframes on an experimental basis.

The F-80C tests are scheduled in an effort to determine the complete suitability of magnesium for fighter planes.

TV to Replace Instruments

▶ A VERTICAL transparent television tube that may replace part of the front pane of an airplane's windshield has been developed in the Navy's long range plan to simplify cockpit design.

This revolutionary tube along with another flat plate television tube that would lie horizontally in front of the pilot is expected to replace all the scattered dials that are presently built into a plane's instrument panel.

During "blind" flying, the front tube would show an abstracted picture of what the pilot would see if there were no clouds to block his view. The bottom tube would show the geography of the area for navigation and traffic control purposes. Although the vertical screen is directly in the pilot's line of vision it will not interfere with his visibility, since he can see right through it, even when the image is projected. The screen is made of two plates of glass with a phosphor screen between.

Special data, such as fuel supply and power readings, could be superimposed instantly on one of the screens by pressing one of the six special levers on the instrument panel.

The Navy's ultimate goal is to replace all the dials, lights and gauges, that clutter the instrument panels of modern airplanes, with these two TV

tubes. The principle of representing flying data in graphic form rather than with isolated dials is based on research in human engineering. It has been found that pictures are more quickly comprehended than the maze of conventional instruments.

The transparent screen was developed by Willys Motors, Inc., Electronics Laboratory in Palo Alto, Calif., and the entire program of simplifying cockpit design is being coordinated by Douglas Aircraft Company.

The aim of the program is to perfect the installation of these tubes, models of which are already in operation, and to reduce flying controls to two items, a throttle and a control stick. A plane with such equipment is expected to be flight tested in about 1958, a Navy spokesman said.

For Vertical Take-Off

➤ A NEW TYPE of experimental wing flap that would allow vertical take-off for conventional looking planes was tested at Langley Air Force Base, Va., by the National Advisory Committee for Aeronautics.

In the new scheme, fast moving, triple-bladed propellers with a somewhat larger than usual diameter are mounted on the wings in conventional position. They thrust back high velocity winds that are deflected downward by movable wing flaps to achieve the lift.

Once the plane is in the air the flaps could be set in horizontal position for normal flight. The report states, however, that the laboratory experiments were designed only to test vertical take-off. No provision was made for forward flight.

The tests showed that the propeller backwash would be deflected 67 degrees downward with the system. The scientists pointed out that it is not necessary to bend the wings a full 90 degrees. The nose of the plane could be tilted upward at take-off.

Results of the experiments were reported by Richard E. Kuhn and John W. Draper, NACA scientists.

Rubber "Cans" For Shipping Chemicals

➤ REUSABLE, collapsible synthetic-rubber "cans" have been developed for industrial shipment of foods, chemicals and corrosives. They are said to cut handling and packaging costs and permit low-cost bulk shipment.

Made by the U. S. Rubber Company, the "cans" now are carrying carbon black, starch, clay, flour, sugar, malt, granular reclaimed rubber, corrosive chemicals and plastics.

The large, 2,500 gallon container measures eight feet in diameter. Inflated it stands eight feet tall, but it collapses to two feet for return and refill. The small, 500-gallon container is three feet, ten inches in diameter and seven feet tall. It collapses into a package about six feet long, three feet wide and ten inches tall.

Fabricated like tires, the containers have a number of plies of high-strength cord molded into the neoprene rubber walls. They are reinforced by internal lifting cables attached to a lifting ring on top.

Scientists Foresee Enough Energy, Materials For Future

No Fear of Starvation Amid Plenty

FUTURE GENERATIONS in the world will continue to have energy and raw materials, despite gloomy predictions to the contrary, it is evident from scientific reports to the American Association for the Advancement of Science.

Evan Just, vice president of Cyprus Mines Corporation of New York, believes that no raw material shortage can be foreseen that will cramp our expanding world economy or endanger cultural progress. Some minerals may be depleted eventually, even though supplies may be extended very far by discoveries of new deposits, new methods of utilization or by curbing waste. Nevertheless, Mr. Just finds that mineral materials may be considered practically inexhaustible. An era of discovery of minerals by scientific prospectors is seen, similar to the extraordinary result of oil exploration in recent years.

Oil, lead, zinc, copper, tin, and the ferro-alloys will last for hundreds of years for their essential uses. When they finally come to an end they will be eliminated altogether in favor of materials of common rocks or ceramic materials.

So far as energy is concerned, Prof. Farrington Daniels of the University of Wisconsin predicts that utilization of sun energy by two methods will rescue the world from an energy death, even after the coal, petroleum and gas to which our present civilization is geared are exhausted within a short time. Prof. Daniels foresees that solar energy will compete with animal power and manpower in non-industrialized areas.

"The world needs a poor man's solar engine," Prof. Daniels said. The long-range hope of utilizing solar energy lies in photoelectricity. Prof. Daniels expects man to be able to duplicate within a short time what the green leaf can do in storing up sunlight energy and do it with much higher efficiency. Direct generation of electricity in transistor types of photovoltaic cells as recently announced appears very promising. Atomic energy will also add to the future source of world power, but man will have to learn to control radioactivity, just as he learned to control fire. Prof. Daniels suggests that more emphasis should be placed on simplicity and low cost of nuclear reactors rather than on precision and perfection.

A plentiful supply of the chemicals obtained from petroleum that make plastics, dyes, paints and synthetic fibers and films will be forthcoming in the next few years, W. G. Poland of the California Research Corporation, Richmond, Calif., told the scientists. These products are based upon the family of organic acids known as the phthalic, which are now made from constituents of high octane gasoline called xylenes. Oil refineries are now geared to produce large quantities of these materials.

XUM

Changing Birth Rate

➤ ONE OF THE major worries of the world, whether the earth will become so filled with people much of humanity will starve to death, is taking care of itself, facts presented to the American Association for the Advancement of Science seem to indicate.

As civilization became more industrialized in the Western countries, their birth rates declined, so much so that there was a race suicide scare. Simultaneously, better health and increased food gave the so-called underdeveloped countries a population spurt, creating fear that the least developed peoples might take over the world.

This unequal population growth "unleashed by the splendid success of our civilization in preserving human life" will continue in all major regions through 1980, but Dr. Dudley Kirk of the Population Council, New York, reported that Asia and Latin America may be expected eventually to slow their momentum of population growth.

The choice between balance of births and deaths and periodic population reduction through famine, epidemics and war will be made in the next two or three generations by action of individuals and not by governmental policies.

Both Soviet Russia and Japan have checked birth rates that were causing concern to other nations. The present Soviet birth rate of 24 per thousand population, slightly less than in the United States, is a drop from the prewar figure of 38 per thousand. The Japanese rate is 21.5, below that of the United States and rapidly approaching European levels.

Atomic war might wipe out enough people to influence population, but Dr. Kirk pointed out that only about five per cent of world population lives in the 60 cities of more than a million population that would be prime atomic targets. The destruction of all our major cities would not directly destroy a large part of the human race, he observed.

In considering human survival, Dr. Kirk computes that four or five normal years of world population growth would completely replace numerically the United States population and six years would replace that of the Soviet Union.

Scum Will Help Grow Food

➤ A WAY of increasing the world's rice crop without use of costly added nitrogen fertilizer has been discovered. It consists of encouraging the growth of blue-green scum hitherto considered a nuisance in the water of the rice paddies.

Dr. Daniel I. Arnon of the University of California's department of plant nutrition told the American Association for the Advancement of Science meeting in Berkeley, Calif., that blue-green algae are a valuable source of nitrogen that they snatch from the air. If these microscopic plants are inoculated into the rice fields, much as nitrogen-fixing bacteria are added to legume fields, they can provide the equivalent of many tons of nitrogen fertilizer for each field.

Dr. Arnon and his associate in this research, Dr. Mary Bell Allen, expect that this new method could be of great importance to the underdeveloped areas where rice is a great food crop.

The blue-green algae have an ability to fix nitrogen from the air 200 times the rate previously estimated. Instead of being a dirty contaminant of rice fields, the hardy colorful growth will now be encouraged and actually planted along with the rice.

Dr. Arnon suggests that this natural source is the reason that rice fields in the orient have remained fertile and productive over thousands of years without any additions of manufactured fertilizer.

The algae can add to the rice land much more nitrogen than could possibly be provided by fertilizer applications.

Blue-green algae can live and thrive on air and sunlight with just a little calcium, sodium, phosphorus, potassium and sulfur and traces of molybdenum and manganese such as exist in most rocks. This allows them to be the first form of life that reestablishes itself by invading rocks that have been denuded by a volcanic eruption.

If man ever has to turn to the algae for raw material, perhaps food, Dr. Arnon believes that the blue-green algae would do a better job than Chlorella, which has been talked about as a favored food microorganism. It grows even faster. But Dr. Arnon is not convinced that we shall ever have to eat algae, for the new enhancement of the rice crop and other scientific methods of increasing food yields should help feed the hungry world.

Instead of algae-eating, Dr. Arnon expects synthetic photosynthesis, upon which he is working, to come to the rescue.

Roses Red, Violets Blue, Found in Flavor of Tomato Goo

▶ TOMATO FLAVOR is a blend of three odors described as "typical," "raw" and "green," plus dozens of secondary flavors ranging from "sweet, flowery and minty" to "rubbery" and "slightly musty," in a study made in Berkeley, Calif., to help preserve the best taste in tomato paste preparations. Odors that contribute to the tomato's flavor were described by the scientists making the analysis as those of rose, violet, lemon, peppermint, caramel, vanilla, carrots, citronella and sulfur.

By drawing off vapors at different points in the commercial processing machinery producing tomato juice, Mary S. Spencer of the department of home economics at the University of California and William L. Stanley of the U. S. Department of Agriculture's Western Utilization Research Branch at Albany, Calif., obtained the flavors concentrated in a thimbleful of a yellow oil which represented from two to 10 tons of tomato juice.

By separating the flavor concentrates by the process of chromatography and applying chemical tests, the researchers spotted unsaturated compounds which are probably to blame when tomato products develop "off flavors." The study was reported in the American Chemical Society's *Journal of Agricultural and Food Chemistry*.

Two-Inch Tube Can Carry Voices on New Frequencies

Copper Pipe Helps Communication

➤ HUNDREDS of thousands of simultaneous telephone conversations may soon be crammed into a single two-inch pipe and transmitted for long distances on wave frequencies higher than have ever been used in communications.

The capacity of the new copper pipe, called a circular wave-guide, exceeds that of the most modern eight-tube coaxial cable which can handle only 7,400 two-way conversations at a time.

The pipe could also carry cross-country television programs. Ordinarily one TV channel takes up the space of about 600 telephone contacts.

The frequency of the microwaves used in the tube ranges from 35,000 to 75,000 megacycles, up to seven times higher than had been found practical before.

In addition, the number of different frequencies that this tubing can carry is so huge that all conventional transmission wavelengths of all media could fit in its spread with ease.

But the seemingly limitless capacity of the tube is reduced greatly since each individual conversation or television channel must be widely separated to eliminate interference.

Stewart E. Miller, assistant director of radio research for Bell Telephone Laboratories, who developed the device, stated that his team's experiments with 500 feet of the tubing was the first demonstration that a circular waveguide is practical for long distance communication. He said the tubes may be put into actual use in five to ten years.

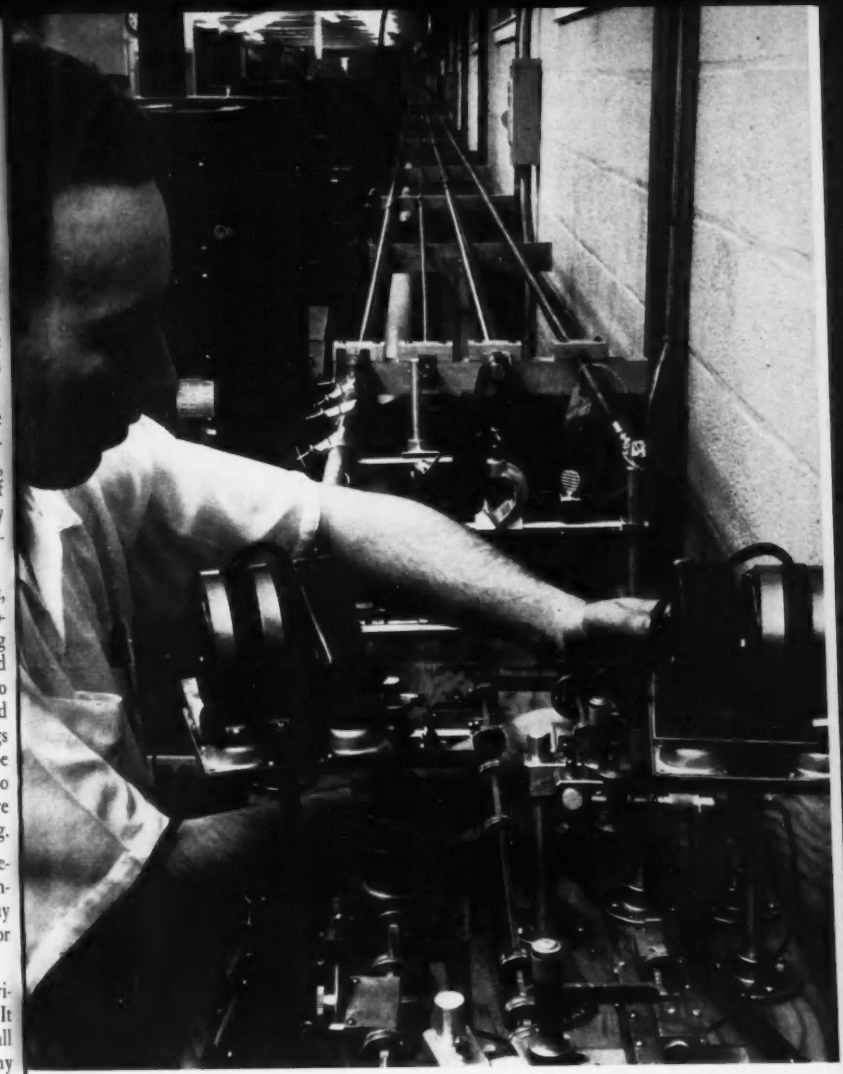
Up to this time waveguides have only been used to transmit lower frequency signals for short distances, such as from the ground to the top of a radio tower. The most commonly used form is the rectangular waveguide, a box-like tube.

Great care, Mr. Miller pointed out, must be taken when bends are introduced into these tubes. Interfering echoes are set up when they are turned around a corner, but he offered two solutions to this prob'em. One would be to build insulated copper rings into the pipe at turns, which would be very expensive. The other would be to make the tube of fine coiled wire wrapped by a flexible outer coating.

Such tubes which have been developed could negotiate the bends without great losses, he said, and may eventually be the sort employed for long distance transmission.

The solid pipe used in the experiments presents other problems too. It must be perfectly straight. Even small dents cause considerable losses. Tiny factors, such as which way the tube is polished, circularly or lengthwise, also affect transmission.

The problem of turns does not arise



▶ NEW WAVE GUIDES *are long, smooth copper pipes which contain microwaves of very high frequencies. These may come into use to transmit wide bands of TV impulses in place of present-day coaxial cables. This experimental set-up is in the Bell Telephone Laboratories at Holmdel, N. J.*

in coaxial cables, which such tubing might supplement or replace.

Tiny super-high frequency waves that move through the new pipe have been almost entirely useless up until now. They are even too small for radar, since they bounce off dust particles and water droplets in the air.

Mr. Miller and his associates found, however, that the higher the frequency generated in the tube, the more efficient it becomes. Such super-high frequency waves were reflected back and forth inside a 500-foot-long pipe in the experiments. Tests showed that the loss in energy was so small that boosters would only be necessary every 25 miles.

After analyzing an impulse that had traveled a total of 40 miles back and forth inside the experimental tube, the Bell Laboratories engineers noted:

"The pulse shape was essentially the same as that of the transmitted pulse, although background noise became clearly visible. We certainly can conclude from this that circular electric wave transmission over great distances is possible."

The background noise, Mr. Miller said, can be easily eliminated.

These results were based on the work of Drs. S. A. Schelkunoff and G. C. Southworth, Bell scientists who discovered the new mode of transmission some 20 years ago.

Soft Wax From Pineapple Waste

▶ Following the successful application of a hard wax derived from Spanish moss for polishing cars, woodwork and leather, scientists have now produced a soft wax from the pineapple.

In experiments conducted at the University of Florida, Seldon D. Feurt and Lauretta E. Fox of the college of pharmacy report in the journal *Science* that they derived a soft wax that melts at 123.8 degrees F., from the waste of pineapple fruits.

They also report that they have found hard waxes in other plants belonging to the same family as Spanish moss, in an effort to catalogue what species would be best for cultivation if Spanish moss wax became a commercial item.

Rice Disease Due to Excess Iron

▶ Although New York is not a rice-growing state, three scientists at Cornell's College of Agriculture, Ithaca, N. Y., have discovered what appears to be the cause of a widespread rice disease, known in Java, Malaya, Ceylon, India and Burma.

Browning of rice leaves and roots was observed in greenhouse tests of rice grown in submerged soil and traced to too much ferrous iron. No disease organisms were found to account for the effect. The symptoms were somewhat like those of potassium deficiency.

The Cornell agronomists who published their report in the British science journal, *Nature*, are F. N. Ponnamperuma, R. Bradfield and M. Peech.

For The Home Lab

The Perkin Condensation

Synthesis of Coumarin

by BURTON L. HAWK

THUS FAR we have limited ourselves to the discussion of general organic reactions such as oxidation, reduction, nitration and halogenation. There are also more specific types of reactions, such as the Perkin condensation, which we would like to consider now. The Perkin reaction, named after its originator, consists of heating together the salts of certain acids with a suitable aromatic aldehyde and the anhydride of the appropriate acid. Thus, cinnamic acid can be prepared by heating benzaldehyde with acetic anhydride and sodium acetate. With sodium propionate and propionic anhydride, *a*-methylcinnamic acid is obtained. Heating together salicylaldehyde, acetic anhydride, and sodium acetate will produce coumarin.

Coumarin occurs in the Tonka bean, woodruff, and sweet clover. It is partly responsible for the refreshing odor of new-mown hay. Coumarin itself has a pleasant, fragrant odor similar to that of the vanilla bean, which in great dilution resembles new-mown hay. It is used in perfumery and as a flavoring agent.

For best results, special equipment should be used to perform this experiment. This makes it a little difficult to carry out in a home laboratory. But, perhaps you can borrow some equipment from a school or commercial laboratory. Or, if you are the inventive type, you can probably devise your own equipment. We are definitely not of the latter class, so we borrowed the equipment from the Wilson-Martin laboratories in Philadelphia. Our thanks to them and to Mr. William Rapp for his valuable collaboration in performing the experiment.

We used a round bottom, short neck boiling flask with a thermometer well and Ts glass joint. Capacity: 200 ml. Joint size: 24/40. Brand: "Pyrex"—Corning Nos. 4323 and 4324. With this flask was used a Liebig-type condenser with Ts joint at the bottom which fits snugly in the top of the flask. ("Pyrex" brand, Corning No. 2360.) Thus no cork or rubber stoppers are needed. The test tube fused in the sides of the flask is used to hold a thermometer. Fill this tube partially with paraffin oil. The oil acts as a heat-transfer agent and its temperature will represent the temperature of the liquid inside the flask. The condenser is in-

serted in an upright position and cooled by running water through it. This arrangement will allow us to boil the reaction solution for a long period of time without evaporation.

Before you begin, make sure all equipment is thoroughly clean and dry. After washing, rinse all vessels with alcohol and then with petroleum ether. Wait a few minutes for the solvent to evaporate completely and the equipment will be ready for use.

Place in the flask 32 grams of *anhydrous* sodium acetate and ½ gram of iodine crystals. (The anhydrous sodium acetate can be prepared from the crystalline variety by heating gently in an evaporating dish until all water is driven off. Stir constantly, and pulverize the product in a mortar.) Next, pour 18 cc. of salicyaldehyde and 30 cc. of acetic anhydride (*careful!*) into the flask.

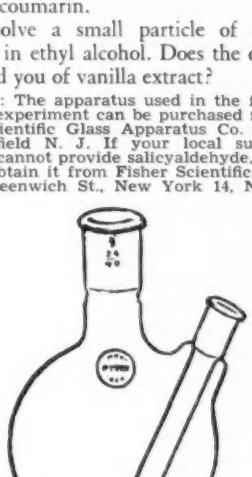
Insert the reflux condenser in the flask and a thermometer in the paraffin oil which is in the side tube. Apply heat until a temperature of 120 deg. is reached and continue heating at this temperature for two hours. Then increase the temperature to 180 degrees and hold as near as possible to this temperature for an additional five hours. If necessary, you may discontinue the reaction, stopper the vessels, and continue heating at another time. The most difficult part of the experiment is to hold a constant temperature over such a long period of time.

After the heating is completed, allow the contents to cool somewhat and pour into about 50 cc. of water, stirring rapidly. Of course, keep your face away to avoid any splattering. The coumarin is present in this liquid. To separate it, we must extract with ether in which it is very soluble. Pour in 30 cc. of ether and stir thoroughly for about 5 minutes. Allow the mixture to stand and then carefully pour off the ether (top) layer. Be very careful when working with ether. Remember it is highly flammable and its vapor mixed with air is explosive. Use adequate ventilation and keep away from all open flames.

No doubt there will be some unreacted salicyaldehyde present. To remove it, shake the ether solution with a concentrated solution of sodium bisulfite. Again, allow the mixture to stand and pour off the top ether layer. Next, "wash" the ether by adding water, shaking thoroughly and again pouring off the top layer as before. Finally, pour the ether solution in a shallow dish and allow it to evaporate. Do not apply heat! The residue is crude coumarin.

Dissolve a small particle of coumarin in ethyl alcohol. Does the odor remind you of vanilla extract?

NOTE: The apparatus used in the foregoing experiment can be purchased from the Scientific Glass Apparatus Co. Inc., Bloomfield N. J. If your local supply house cannot provide salicyaldehyde, you may obtain it from Fisher Scientific Co., 635 Greenwich St., New York 14, N. Y.



Will Rubber Roads Mean Stretched Dollars?

Rubber as Paving Material

HIGHWAY research experts are probing the mysteries of rubber roads with a dogged scientific curiosity. A question in their minds: Will rubber roads stretch the taxpayer's dollar? The answer today is neither "yes" nor "no."

"We know so little about them that we just can't say," Highway Physical Research Engineer J. York Welborn says. Since 1950, he and Richard H. Lewis, senior chemist at the Physical Research Branch of the Bureau of Public Roads, have been testing 14 types of rubbers on three typical asphalts. The asphalts are widely used on the East Coast, in the Midwest and on the West Coast.

In two cases, test results indicate that the asphalt may withstand cracking better in cold weather. This is a dollar-stretching quality in winter when heavy trucks would be rolling over them. In most cases, rubbers also seemed to improve the material's resistance to blazing noontime suns.

The "give," or elasticity, of one asphalt was raised by the tested rubbers. This is a desirable quality because highways are sometimes stressed severely.

Although many miles of experimental rubber roads now exist in the United States, it has been impossible for the Public Roads scientists to check laboratory findings against the actual performance of these roads.

Ordinary testing methods, which would be used in such comparisons, do not work properly when rubber is in the paving mixture.

It now appears that scientists may have to wait until the rubber roads wear out before drawing conclusions. The first real rubber road was laid in 1948 on Exchange Street in Akron, Ohio. Mr. Welborn said it may last 15 or 20 years.

Meanwhile, Harry M. Rex, supervising highway physical research engineer, and Robert A. Peck, highway research engineer, also of the Physical Research Branch, have tried out ways of mixing rubber into the paving material. When rubber powder is added to the aggregate, the surfacing is harder to compact, and the pavement is more apt to melt in hot weather or crack in cold.

But when the rubber was blended with hot asphalt before being poured over the aggregate, the surface was more easily compacted and was more stable than mixtures containing powdered rubber.

A combination of Ottawa sand, preblended asphalt and natural rubber yielded a material more resistant to abrasion. Mr. Rex interpreted this as meaning that snow chains may not do as much damage as on less-resistant surfaces.

Mr. Rex said rubber road research is a "continuing thing." New rubbers may be developed in the future which may even outmode the rubbers that now seem best for the job.

Effects of Detonations On the Ground Below

Nuclear Explosion Effects

Extracts from A Report by the United States Atomic Energy Commission on the Effects of High-Yield Nuclear Explosions, released by the A.E.C. February 15, 1955.

➤ A NUCLEAR detonation produces four major characteristics—blast, heat, immediate nuclear radiation, and residual radioactivity. Of these, the first three are essentially instantaneous, while the fourth has a more protracted effect. The phenomena of blast, heat, and nuclear radiation from the detonation of a thermonuclear bomb are of the same nature as those of earlier and smaller atomic bombs. The nature of the phenomena is, in general terms, standardized whether the bomb be a 20,000-ton (TNT equivalent) atomic weapon or a thermonuclear one of many times that power. The intensity and area of the blast, heat and nuclear radiation increase in relation to the greater energy yield of the explosion. Information on these effects has been extensively publicized; therefore, the remainder of this report deals principally with effects other than heat and blast.

Residual radioactivity, although in no sense exclusive to high yield thermonuclear detonations, does become a matter of major concern when a large thermonuclear device of the type used in the 1954 tests in the Pacific is exploded. The fallout of radioactivity from such an explosion may, under certain conditions, settle over wide areas. Therefore, the extent and severity of this radioactive fallout has been a subject of continuing study since the first full-scale thermonuclear tests at the Pacific Proving Grounds on November 1, 1952. The results of these studies and of our evaluation of data obtained from the latest tests in the Pacific in March, 1954, are described in subsequent parts of this report.

It should be noted that if we had not conducted the full-scale thermonuclear tests mentioned above, we would have been in ignorance of the extent of the effects of radioactive fallout and, therefore, we would have been much more vulnerable to the dangers from fallout in the event an enemy should resort to radiological warfare against us.

Blast and Heat Effects

The effects of blast and heat from a nuclear explosion are relatively localized. One A-bomb of the earliest type equivalent to 20,000 tons of TNT (20 kilotons) would produce blast sufficient to destroy or damage severely residences within a radius of more than one mile from the point of burst. Within a radius of about a mile and a half, residences would be so damaged as to be unusable without repairs. A principal hazard to human beings would come from flying and falling debris and from fires due to such causes as broken gas and electric lines or overturned stoves. The area in which injuries to human beings would

be caused by blast, therefore, would be about the same as the area of damage to structures.

The United States, as announced previously, has developed fission bombs many times as powerful as the first A-bombs, and hydrogen weapons in the ranges of millions of tons (megatons) of TNT equivalent. For these larger weapons, the blast effects can be calculated approximately by means of a scaling law, namely, the distance at which a given blast intensity is produced varies as the cube roots of the yields of the explosions.

Similarly, the heat and burn effects of nuclear explosions can be estimated from accumulated data. These effects, of course, are influenced by prevailing atmospheric conditions. The time element also is a prime factor. Very large weapons deliver heat over an appreciably greater period of time than smaller weapons. A given quantity of heat from a high-yield weapon, delivered over a longer period of time, will produce somewhat *less* severe burns than the same quantity of heat from a nominal detonation.

Protection Against Blast

The hazard from both burn and blast effects in the *outer* affected areas would be reduced greatly by shelter. Clothing or almost any kind of shelter would reduce the danger of direct burns, although there might be some danger of clothing and structures becoming ignited. Also, shelter would materially reduce the hazard of blast injury by affording protection against flying or falling debris. The Federal Civil Defense Administration has made extensive study of shelters and has issued plans for several simple and inexpensive types which can be utilized by householders. As is generally known, the shelter afforded by ordinary city buildings would not suffice within the central area surrounding the point of burst of a large nuclear weapon. For this reason, the Federal Civil Defense Administration recommends evacuation of the central areas of target zones on early warning of approaching attack.

Radiation Effects

The immediate nuclear radiation, i.e., the neutrons and gamma rays released instantaneously with the explosion of a large weapon on or near the ground, does not present a serious hazard beyond the area where heat and blast are of great concern.

Fallout Radiation

However, particles with residual radioactivity produced by a detonation (as opposed to the immediate nuclear radiation) may fall out over an area much larger than that affected by blast and heat, and over a longer period of time. All nuclear detonations produce radioactive materials, but the nature and extent of the radioactive fallout depends on the conditions under which the bomb is fired. The main radioactivity of a bomb's fallout decreases very rapidly with time—for the most part, within the first hours after the detonation.

In-the-Air Detonations

In an in-the-air explosion where the fireball does not touch the earth's surface, the radioactivity produced in the bomb condenses only on solid particles from the bomb casing itself and the dust which happens to be in the air. In the absence of material drawn up

from the surface, these substances will condense with the vapors from the bomb and air dust to form only the smallest particles. These minute substances may settle to the surface over a very wide area—probably spreading around the world—over a period of days, or even months. But they descend extremely slowly with the result that, by the time they have reached the earth's surface, the major part of their radioactivity has been dissipated harmlessly in the atmosphere, and the residual contamination is widely dispersed.

Surface Detonations

If, however, the weapon is detonated on the surface or close enough so that the fireball touches the surface, then large amounts of material will be drawn up into the bomb cloud. Many of the particles thus formed are heavy enough to descend rapidly while still intensely radioactive. The result is a comparatively localized area of extreme radioactive contamination and a much larger area of some hazard. Instead of wafting down slowly over a vast area, the larger and heavier particles fall rapidly before there has been an opportunity for them to decay harmlessly in the atmosphere and before the winds have had an opportunity to scatter them.

The area of hazard from radioactive fallout from a surface or near-surface explosion of a thermonuclear weapon is much larger than the areas seriously affected by heat and blast. The large radioactive cloud of a thermonuclear explosion rises with great rapidity to the highest levels of the atmosphere and spreads over hundreds of square miles in the first hours. During this time the winds toss the extremely radioactive particles about and the pattern of the radioactive fallout is determined by the size of the particles and by the direction and velocities of the winds, including those up to 80,000 feet and above. The nature of the surface of the earth on which the bomb is fired also must be taken into consideration. Because of these variables, it is impossible to apply a single fallout pattern to all thermonuclear detonations, even test explosions conducted under selected conditions. However, with adequate knowledge of atmospheric conditions, including wind directions and velocities up to high levels and meteorological reports, the fallout region for any detonation usually can be predicted with considerable accuracy. In general terms, the region of severe fallout contamination from the detonation of a thermonuclear weapon fired on or near the surface can be described as an elongated, cigar-shaped area extending down-wind from the point of burst.

1954 Test in the Pacific

The very large thermonuclear device fired at the BikiniAtoll on March 1, 1954, was exploded on a coral island. Coral consists of calcium carbonate, thus the detonation's radioactivity was spread by particles consisting largely of unslaked lime which, during the hours of descent, was slaked by moisture in the atmosphere. These particles ranged between 1/1000th and 1/50th of an inch in diameter and were, on the average, somewhat adhesive. The prevailing winds were westerly so the bomb cloud moved generally to the east and deposited the radioactive particles in

varying amounts over an elliptical or cigar-shaped area. About 160 (statute) miles down-wind from the point of burst the early fallout was observed in the form of fine particles which looked like snow. Fallout began there about eight hours after the detonation and continued for several hours.

The roentgen is the commonly accepted unit of measurement of radiation dosage. A dose of about 25 roentgens of radioactivity received by a person over a brief space of time will produce temporary changes in the blood. A dose of some 100 roentgens received in a short interval may produce nausea and other symptoms of radiation sickness. About 450 roentgens delivered over a day or so might be fatal to approximately half of the persons so exposed. However, because of the body's repair processes, a total radiation dose which would be serious if incurred in a few minutes would produce much less effect if spread over a period of years. These statements may be helpful in understanding the data which follow.

The test explosion, at ground surface, contaminated a cigar-shaped area extending approximately *220 statute miles down-wind and varying in width up to 40 miles.* In addition, there was a contaminated area up-wind and cross-wind extending possibly 20 miles from the point of detonation. Data was collected from 25 points on 5 atolls located from 10 to 330 miles down-wind (generally east) from Bikini Atoll. Due to an unexpected shift in the direction of the prevailing winds in the higher altitudes, the fallout missed the observation rafts that had been placed farther north previous to the test firing. The estimated contour of the pattern of fallout is, therefore, based only in part on data obtained from actual measurements and partly on extrapolation, i.e., calculations based on known data, including factual information obtained during previous tests of smaller devices.

Data from this test permits *estimates* of casualties which would have been suffered within this contaminated area if it had been populated. These estimates assume: (1) that the people in the area would ignore even the most elementary precautions; (2) that they would not take shelter but would remain out of doors completely exposed for about 36 hours; and (3) that in consequence they would receive the maximum exposure. Therefore, it will be recognized that the estimates which follow are what might be termed *extreme estimates* since *they assume the worst possible* conditions.

On the basis of our data from this and other tests, it is estimated that, following the test explosion on March 1, 1954, there was sufficient radioactivity in a down-wind belt about 140 miles in length and of varying width up to 20 miles to have seriously threatened the lives of nearly all persons in the area who *did not take protective measures.* During the actual tests, of course, there were no people in this zone. Inside Bikini Atoll at a point 10 miles down-wind from the explosion it is estimated that the radiation dosage was about 5000 roentgens for the first 36-hour period after the fallout. The highest radiation measurement outside of Bikini Atoll indicated a dosage of 2300 roentgens for the same period. This was in the northwestern part of

the Rongelap Atoll, about 100 miles from the point of detonation. Additional measurements in Rongelap Atoll indicated dosages, for the first 36-hour period, of 2000 roentgens at 110 miles, 1000 roentgens at 125 miles, and, farther south, only 150 roentgens at 115 miles from Bikini.

Some distance farther from the point of detonation, at about 160 miles down-wind and along the axis of the ellipse, the amount of radioactivity would have seriously threatened the lives of about one-half of the persons in the area who *failed to take protective measures*. It is estimated that the radiation dosage at that point was about 500 roentgens for the first 36-hour period.

Near the outer edge of the cigar-shaped area, or approximately 190 miles down-wind, it is estimated that the level of radioactivity would have been sufficient to have seriously threatened the lives of 5 to 10 per cent of any persons who might have remained exposed out of doors for the first 36 hours. In this area the radiation dosage is estimated at about 300 roentgens for the first 36-hour period.

Thus, about 7,000 square miles of territory down-wind from the point of burst was so contaminated that survival *might* have depended upon prompt evacuation of the area or upon taking shelter and other protective measures.

At a distance of 220 miles or more down-wind, it is unlikely that any deaths would have occurred from radioactivity even if persons there had remained exposed up to 48 hours and had taken no safety measures.

The estimates cited above do not apply uniformly throughout the contaminated area inasmuch as the intensity of radioactivity within a region of heavy fallout will vary from point to point due to such factors as air currents, rain, snow, and other atmospheric conditions. Because of this and because most persons, if given sufficient warning, probably would evacuate the area or take shelter and other precautionary measures, the actual percentage of deaths could reasonably be presumed to be considerably *smaller* than these extreme estimates.

Protection Against Fallout

In an area of heavy fallout the greatest radiological hazard is that of exposure to *external* radiation. Simple precautionary measures can greatly reduce the hazard to life. Exposure can be reduced by taking shelter and by utilizing simple decontamination meaures until such times as persons can leave the area. Test data indicate that the radiation level, i.e., the rate of exposure, indoors on the first floor of an ordinary frame house in a fallout area would be about one-half the level out of doors. Even greater protection would be afforded by a brick or stone house. Taking shelter in the basement of an average residence would reduce the radiation level to about one-tenth that experienced out of doors. Shelter in an old-fashioned cyclone cellar, with a covering of earth three feet thick, would reduce the radiation level to about 1/5000, or down to a level completely safe, in even the most heavily contaminated area. Designs of shelters of simple yet effective construction have been prepared by the Civil Defense Administration and are available to the public.

Radioactive material deposited during fallout may or may not be visible but would be revealed by radiation detection instruments such as Geiger counters. Any falling dust or ash that can be seen down-wind within a few hours after a nuclear explosion should be regarded as radioactive until measured by a radiation detection instrument and found to be harmless.

Care should be taken to avoid the use of solid foods or liquids that may contain fallout particles.

If fallout particles come into contact with the skin, hair or clothing, prompt decontamination precautions such as have been outlined by the Federal Civil Defense Administration will greatly reduce the danger. These include such simple measures as *thorough bathing of exposed parts of the body and a change of clothing.*

If persons in a heavy fallout area heeded warning or notification of an attack and evacuated the area or availed themselves of adequate protective measures, the percentage of fatalities would be greatly reduced even in the zone of heaviest fallout.

Fallout From Nevada Tests

Only relatively small nuclear test explosions are conducted at the Nevada Test Site, in contrast to the tests of high-yield thermonuclear devices at the Pacific Proving Grounds. In Nevada, as well as in the Pacific, all tests are planned for times when forecast weather conditions minimize the possibility of fallout hazard. Methods of forecasting weather patterns in these areas are improving steadily. High air bursts at the Nevada Test Site have produced no significant fallout; heavy fallout from near-surface explosions has extended only a few miles from the point of burst. The hazard has been successfully confined to the controlled area of the Test Site. The highest actual dose of radiation at an off-site community has been estimated to be *less than one-third of the greatest amount of radiation which atomic energy workers are permitted to receive each year under the Atomic Energy Commission's conservative safety standards.*

Internal Radiation Effects

Several basic facts should be kept in mind in evaluating the hazard from fallout radiation. First, radiation is not a new phenomenon created by the explosion of fission and thermonuclear weapons. Since the beginning of life, living things have been exposed constantly to radiation from natural sources. Cosmic rays from space constantly pass through our bodies. We are exposed to "background" radiation from radium and radon in the soil, water and air. Our bodies have always contained naturally radioactive potassium and carbon.

As pointed out earlier, detonations of all atomic weapons produce radioactivity, a portion of which is carried to high altitudes and over great distances in the form of fine particles. The percentage of this radioactivity which travels beyond the relatively near area of the explosion depends largely on the conditions under which the bomb is fired, the percentage being higher for in-the-air bursts where the fireball does not touch the earth's surface. The most widespread radioactivity is produced only by the longer-lived fission products, since the radio-

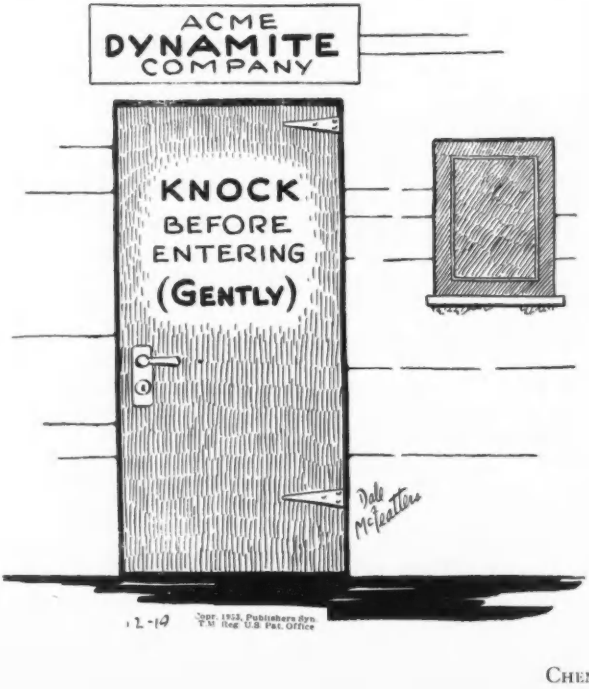
activity of the shorter-lived products decays and disappears before the particles come down to earth in a matter of days, weeks, months, and even years. The longer-lived radioactive products may be distributed over the entire earth. However, as the particles are carried farther and farther to remote areas, the possibility of significant amounts of fallout decreases.

Azoton is New Cotton

▶ You'll be wearing azoton clothes and using other sorts of azoton textiles. For "azoton" is the new name for cyanoethylated cotton products, a new variation of an old cloth material.

Announced by the Institute of Textile Technology at the Eighth National Chemical Exposition in Chicago, the new name is derived from "azote," French for nitrogen, and the end of the word cotton. Azoton is made by reacting a nitrogen-containing compound, acrylonitrile, with cotton.

This produces a new fiber material which is superior to cotton. Azoton has improved resistance to wear, heat, rot, chemicals, greater strength, better dyeing qualities and improved electrical insulation characteristics.



Natural Insecticide From Flower's Roots

New Insecticides Help in Bug War

▸A HIGHLY pungent, natural insecticide has been derived from the roots of the American coneflower, which grows wild in Kansas, Nebraska and Missouri.

Designated echinacein, a description of the compound's isolation and its insecticidal qualities in tests with houseflies was reported by Martin Jacobson of the U.S. Department of Agriculture's entomology research branch, Beltsville, Md.

The entomologist stated that the echinacein possesses moderate insecticidal activity, along with the characteristics of pungency found in a number of other insecticidal unsaturated isobutylamides derived from natural sources.

An accidental contact of a trace of the new compound which was formed into acids through permanganate oxidation caused a burn on the skin of the hand, which blistered and then peeled after two days.

Because the echinacein is highly unstable, attempts to identify it further failed. However, Mr. Jacobson reported that the pungent natural insecticide may be identical with another compound derived from the bark of the Herculesclub, sometimes called the toothache tree.

A small amount of the new compound, when placed on the tongue, causes a numbing effect.

Cities' Fly Problem

▸THE COMMON fly's weakness for something sweet to eat may mean that it can be substantially eliminated from plaguing city-dwellers.

A year's study of the effects insecticide-sweetened baits have had on the fly population of cities was reported at a recent meeting of the Entomological Society of America by J. C. Keller of the U. S. Department of Agriculture's research service.

Using insecticides made from organic phosphate compounds, diluted in mixtures of molasses, malt or sugar and water, the baits reduced the fly population at a rendering plant 99% in four hours. At a city dump, the scientist reported, control of houseflies and blowflies ranged between 97% and 99%, 24 hours after treatment.

It was also reported that on garbage and trash piles in a city slum area, daily treatment provided progressively better control until, at the end of five days, the fly population had been reduced 90% or more.

Two of the chemicals, malathion and L 13/59, had proved effective before in controlling insecticide-resistant flies on farms, but the tests also included many new materials, such as chlorthion and an experimental phosphate, OS-2046.

Mr. Keller added that results varied depending upon where baits were used

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and the species of the flies. The research on ridding cities of the fly problem by using baits was done by Mr. Keller, Dr. Carroll N. Smith and H. G. Wilson.

For Use on Mosquitoes

➤ FUTURE generations of mosquitoes that light on man to enjoy a good meal are in for a surprise. A U.S. Department of Agriculture entomologist has reported the discovery of 11 new mosquito-repelling chemicals.

Describing all as being superior against one or more species of mosquitoes to repellents now being used, Dr. Carroll N. Smith reported the discovery to the Entomological Society of America, meeting in Houston, Texas.

One of the new compounds, designated 20218 and known chemically as N,N-diethyl-m-Toluamide, showed remarkable repelling qualities to the malaria, yellow-fever, glades, and two species of the salt-marsh mosquitoes, Dr. Smith stated. When spread on a man's arm, 20218 prevented bites from the yellow-fever mosquitoes for four hours. Presently used standard military repellents protect a man for only one and one-half hours against the same pest.

In further tests, it was found that the bites of the salt-marsh mosquitoes could be prevented for four and one-half hours by applying 20218, whereas standard repellents gave protection for only two and one-half hours. Against the glades mosquitoes, protection was effective for nearly two hours, or one-half hour more than repellents now used.

In tests for protection against the malaria mosquitoes, 20218 proved superior to all other test repellents, and equalled the repellency of standard repellents, the entomologist claimed.

Dr. Smith stated that it is likely that none of the repellents will be available to the public in the near future. Although the new chemicals appear to be safe to use on the skin, further testing is necessary. The research was carried on with funds from the Department of Defense.

Wastes Make DDT, Feed, Fertilizer

➤ INDUSTRIAL wastes which have been polluting streams and air are now used to make such products as fertilizers, animal feeds and DDT.

C. Fred Gurnham of Michigan State College, an expert on waste utilization, told a meeting of the American Institute of Chemical Engineers that these products could be made through relatively simple alteration of manufacturing procedures. The process in many cases more than pays for the salvage cost.

Wastes from the steel, coal, metal finishing, paper and food industries can be used to make animal feeds and fertilizers.

In washing coal, for example, he said, the rinsing water used to be discharged in the stream. But the residue was found to have such a high market value that not only is it being saved, but sludge deposits from earlier pollution are being dredged from stream bottoms.

How the common industrial waste chemical, hydrochloric acid, could be used to make DDT was reported by Dr. A. J. Teller of Fenn College in Cleveland.

Decay Fighting Chemical Applied Directly to Teeth

Fluoride Tooth Paste

A NEW decay-checking tooth paste is expected to come on the market soon. This one will depend for its anti-decay action on tin fluoride.

"Early reports on new dentifrice are promising; let's hope the promise will be fulfilled" is the editorial comment on it given by the Journal of the American Dental Association.

A year's trial of the new dentifrice by school children resulted in a decrease in the tooth decay rate of 50.6% in teeth that were free of decay at the time of first examination. Use of the tooth paste by the children was not supervised, so that they were using it just as they would use any dentifrice. It was equally effective at different ages.

The dentifrice was given to 209 children whose teeth at the beginning and end of the year's trial period were examined and compared with a control group of 214 children. These 214 also got a special dentifrice which was identical with the decay-checking one except it did not have any fluoride in it.

These studies were made by Drs. Joseph C. Muhler, William H. Nebergall and Harry G. Day of the School of Dentistry and department of chemistry, Indiana University, Bloomington, Ind., and Dr. Arthur W. Radike of Ohio State University College of Dentistry, Columbus, Ohio. They were supported in part by a grant from the Proctor and Gamble Company, Ivorydale, Ohio.

A similar trial is reported under way in Cleveland. Dental scientists and health authorities will be particularly interested in results of this second test, because so many dentifrices have shown great promise on their first trial, only to prove disappointing later.

Putting a fluoride into a dentifrice follows the earlier discovery of the tooth decay checking power of fluorides occurring naturally in drinking water. Many communities are now putting carefully measured amounts of fluoride into the drinking water, to give the benefit of its anti-decay action to children as their teeth are forming.

Fluoride is also put onto the teeth of school children by many dentists as an anti-decay measure.

Putting it into a tooth paste might give the "ideal" way to use it, Dr. Muhler and associates say in reporting their studies to the Journal of the American Dental Association. They favor it because people would get the fluoride on their teeth oftener and more conveniently than by going to the dentist for fluoride treatment.

Whether the fluoride tooth paste would provide too much fluoride for persons living in regions where the water has fluorine in it naturally or by controlled addition is a question

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still to be decided. The decision of this point which may involve a Food and Drug Administration requirement of special labelling is believed to be one thing holding up marketing of the new tooth paste.

Putting fluoride into the drinking water is favored by health authorities who point out it is the best way of being sure all the people of the community get the decay-fighting benefit of fluorides. Whether or not they brush their teeth or go to the dentist, they all drink water.

Quality Label For Potatoes

▶ Scientists are trying to take the guesswork out of potato buying and put it on a label.

Intensive experiments on the nation's various potato varieties are now being conducted to determine just what makes a particular tuber good for baking, boiling, chipping, frying or mashing. Human nutrition and marketing-research scientists of the U. S. Department of Agriculture have already learned that variety, region, year and storage all make a difference in quality.

It is easy to see from the findings, a report to the department's magazine, *Agricultural Research,* states, why a shopper can not tell, just by looking, whether a market lot of potatoes will prove mealy, as potato eaters generally prefer tubers to be for baking or boiling. Mealiness may differ, not only with variety, but in the same variety grown in different locations and in succeeding crop years.

Storage brings changes too, the scientists claim. The longer potatoes were stored, the less mealy and more soggy they became. On the other hand, storage at a low temperature of about 40 degrees Fahrenheit lessened sloughing in potatoes that had a tendency to come apart when boiled whole.

Cooking methods did not affect the mealiness or the dryness of the potato, Mary E. Kirkpatrick, food specialist, reports.

A potato that was dry and mealy when boiled, was dry and mealy when mashed or baked, Miss Kirkpatrick states.

Dry matter, alcohol insoluble solids and starch are all good indicators of the qualities potato eaters prize, Dr. Peter H. Heinze, a plant physiologist, tells buyers. But a simple test of whether a potato sinks or swims in salt water is still a good predictor of its boiling and baking qualities. Sinkers are likely to have a high quality when baked, boiled or chipped; while floaters are likely to have a low quality.

It is the hope of the scientists that potatoes of the future will come to the market, labeled to help buyers select the bakers from the boilers, the boilers from the mashers, the mashers from the fryers; and so on, just like chickens.

Polluted water can look safe, smell safe and taste delicious, yet be as dangerous as poison.

New Essential Nutrient In Fat May Be Vitamin

Fats Stressed in Nutrition News

A NEW vitamin-like substance, occurring in animal fats such as cream, butter and lanolin, has been found essential to life processes in some types of microorganisms.

The discovery of this hitherto unknown nutrient is reported by Dr. Max Dunn, professor of chemistry, and Merril N. Camien, assistant research chemist, at the University of California at Los Angeles.

The two U.C.L.A. chemists point out that while it has not yet been demonstrated that the substance is essential to higher animals, nutritional requirements generally carry over from lower forms of life to higher species. Some vitamins and other essential nutrients were first discovered in studies with simple organisms.

The new nutrient belongs to a chemical group known as the D-alpha-hydroxy acids, which includes lactic acid, found in milk. Members of this group have analogous but opposite configuration to the commonly occurring L-amino acids, the building blocks of proteins.

D-alpha-hydroxy acids occur naturally in certain animal fats but not in most vegetable fats.

Organic Fats and Growth

THE SIGNIFICANCE of the relationship between organic fats or lipids and growth is being investigated by Dr. John McMenamim, associate professor of biology at Occidental College, on leave to do research at the University of California at Los Angeles.

He discovered the relationship by stopping the function of the thyroid glands in nine-day old chick embryos.

Just before the 21-day hatching time of normal chicks he examined the embryos and found their growth was three days behind schedule. He also found that lipid levels in their livers were only about half those of normal embryos.

Chickens normally have a high level of lipids, particularly cholesterol. The lipid level of yolk, the growing embryo's food source, is also high. Just before a normal chick hatches there is a marked acceleration in its utilization of these organic fats.

What part these fatty substances play in the development of the chick the last few days before hatching Dr. McMenamim does not know. The fact that the changes in lipid levels paralleled growth retardation seems significant and he plans further experiments to clarify the relationship.

This is perhaps just another link in the increasing chain of evidence, he said, pointing to the importance of these fatty substances in life processes.

Shark For Malnutrition

THE FLESH of sharks and rays caught off the coasts of India has been found to be a high protein food source that is foreseen as a vital and

inexpensive weapon in the world's fight against protein malnutrition.

A finished product with an 85% protein content, or more than twice that of cheese and almost four times that of frozen roast beef, was obtained in laboratory experiments by G. B. Monhanty and A. B. Roy, of the Department of Fisheries, Orissa, India.

Reporting their find in the journal *Science*, the two scientists state that this hydrolyzed fish protein produced from the flesh of waste fish contains all the principal amino acids in amounts that are fairly adequate for human consumption in comparison with other food products.

It is very useful in treating cases of malnutrition, tuberculosis, and duodenal and ventricular ulcers and as a supplement to the diets of convalescent patients, they state.

The general properties of hydrolyzed fish protein are that it is easily soluble in water, it keeps well in powder form, and the whipping power is greater than that of egg albumen.

In addition, the Indian fishery experts report, its properties are such that it could be used in the plastics, paint, leather and rayon-fiber industries.

It has also been found that the utilization of flesh from fish such as sharks and rays, long considered waste, and the lower cost to produce the hydrolyzed fish protein make its production cheaper than many similar products.

After testing the product on only a few patients, the scientists state, the demand has become very great. The investment for establishing a small plant would be moderate. And there is no doubt that the establishment of such a plant would certainly help millions of children and adults dying of malnutrition.

To derive the hydrolyzed fish protein from the flesh of a fish, the product is minced, washed and then boiled in dilute acid and washed repeatedly. The product is then dried and treated to eliminate the fat. Finally, the product is subjected to hydrolyzation. The yield of the finished product is nearly ten percent of the raw material.

For Rare Mental Condition

➤ Discovery of a diet that will raise the I.Q. of mentally defective children suffering from the rare condition, phenylketonuria, is announced by Drs. L. I. Woolf, Ruth Griffiths and Alan Moncrieff of the Hospital for Sick Children, London.

Three small children, two of them idiots and one an imbecile, have been fed this diet for four-and-a-half to 10 months. The mental ages of all three have increased as a marked rate, their I.Q.'s have risen and they may reach an intelligence level that will allow their going to school and being educated.

The previous lack of mental development in these children was due to a defect in the way their bodies handled the amino acid, phenylalanine. About four out of every 100,000 population are born with this defect.

Since phenylalanine poisoning caused the mental deficiency, Dr. Woolf decided to try devising a diet that would not contain this amino acid. Unfortunately, all dietary proteins are about equally rich in content of this particular amino acid.

Dr. Woolf solved the problem by

using an acid hydrolysate of the protein, casein. This material contains all amino acids necessary for good nutrition. By treating it with charcoal, Dr. Woolf extracted the unwanted phenylalanine. This also removed tryptophan and tyrosine, which were put back into the mixture.

The material was fed as a soup cooked with starch and water. Since the patients were young and backward, the oldest being five years, with a mental age of eight months, soup feedings were particularly suitable for them. As they progressed in mentality, a special kind of sugar cookie was allowed. They also got as much water and orange juice and sugar-water as they wanted, plus doses of vitamins and minerals.

For a child with a mental age of over two years, potatoes, carrots and cabbage were added to the diet and the amino acid mixture was fed as a thick gravy flavored with tomato puree instead of as soup.

Backward, or mentally deficient, children who do not suffer from phenylalanine poisoning would not be helped by this diet. A simple test of the child's urine detects the unusual defect in body chemistry. Some patients with epilepsy might also be helped, the studies suggest, since one of the three children stopped having attacks of epilepsy, which had also afflicted him.

Petit mal epilepsy, the scientists state, may also be due to phenylalanine poisoning.

Oil Improves Alfalfa

▶ ALMOST HALF of the nutrient in alfalfa meal needed by poultry and livestock to make vitamin A can be saved by treating alfalfa meal with animal fats.

The nutrient is carotene, a provitamin that animals convert into vitamin A, needed for good growth and reproduction. When alfalfa is cut and dried and then stored as a feed meal, as much as 50% to 75% of the carotene combines with oxygen and disappears.

U. S. Department of Agriculture scientists report that in recent tests the meal treated with five percent of animal fats retained nearly twice as much of the carotene as did untreated meal.

The researchers stated that oiling the dried, chopped alfalfa before it is made into meal also has other advantages. It keeps down dust in dehydrating plants, lessening fire hazards. Employees can dispense with dust masks and work in greater comfort.

Acid From Sulfur Deposits

▶ A NEW PROCESS for extracting sulfur economically from low grade deposits was disclosed at a meeting of the American Institute of Chemical Engineers. The new system promises to insure a continuous and economical supply of the important yellow element.

In the process, finely ground low grade sulfur is roasted at up to 1,600 degrees F. in cylindrical reactors 25 feet high and 18 feet in diameter. A stream of air is fed through the molten ore. The sulfur dioxide gas produced, from ore of 20% to 30% sulfur, can be used to produce 450 tons of sulfuric acid a day.

Common Materials Bettered Chemically

Inventions Interesting to Chemists

Copies of patent specifications may be obtained for 25 cents each from the Commissioner of Patents, U. S. Patent Office, Washington 25, D. C. Order by number and enclose money order, coins or Patent Office coupons, but not stamps.

X-ray Camera

➤ AN X-RAY camera designed to snap pictures of radioactive ores buried deep in the earth has been issued a patent by the government.

Uranium prospectors could use the device to photograph earthly formations that Geiger counters detect. By studying the developed film, prospectors could get a better idea of the extent and richness of the ore.

Invented by John H. Andrews of La Mesa Calif., who received patent No. 2,688,095, the camera uses a series of horizontal and vertical baffles to absorb all radiation not traveling parallel to the camera. Radiation passing through the baffles strikes a window of polystyrene or some other chemical that generates light when hit by radioactive particles.

Multiplier phototubes "see" the light flashes in the window and amplify them. They are passed on to a glow lamp in proportion to their brilliance. The glow lamp exposes the camera's film.

The camera is geared to scan the area under study. The glow lamp scans the film in synchronism so that the picture will make sense.

The camera works on X-rays, gamma rays and other radiations of extremely short wave lengths. It is able to picture ores of weaker intensity than present "pin hole" cameras can, thus widening the vistas for its users.

Corn Cleaner

➤ WHOLE-KERNEL corn is sprayed with electricity by a cleaning machine that won patent No. 2,687,803 for Herbert B. Johnson of Rochester, N.Y., who assigned his rights to The Quaker Oats Company, Chicago.

The usable corn kernels quickly give up their electrical charge to a grounded roller and drop down for further processing. Foreign material—including insects, weevils, rat excreta and seeds—retain the electrical charge longer, dropping off as they pass over a waste-collecting bin.

The machine recovers more usable corn from raw corn mixtures than present devices. The equipment simplifies milling operations, eliminates some machinery, reduces capital investment, as well as power, maintenance and supervision costs. It occupies a relatively small space.

Aluminum-Clad Steel

➤ HEAVY STEEL sections now can be clad with aluminum, yet will withstand severe mechanical distortion or rolling. The process for doing this won patent No. 2,687,565 for Ralph A. Schaefer of Cleveland, and Joseph F. Cerness and Wilber H. Morrison

of East Cleveland. They assigned the patent to Clevite Corporation.

The steel is covered with a layer of cobalt or one of its alloys. A layer of mercury is applied over it. A thick layer of aluminum or an aluminum alloy then can be cast on the mercury and quenched. The resulting product features a tough bond that gives workability to the metal.

Printed Batteries

➤ HIGH VOLTAGE batteries now can be printed on a plastic card to power printed radio circuits. This was revealed by patent No. 2,688,649 issued by the government to Johan Bjorksten of Madison, Wis. He assigned his rights to Bjorgsten Research Laboratories for Electrochemistry, Inc., Madison.

Applied in layers, the printing "ink" contains a metallic powder of any magnetic substance such as iron, cobalt, nickel, or salts, oxides and alloys of these metals. After the layer has been printed, it is thrust into a magnetic field which aligns the metal particles and causes them to touch each other. The liquid medium in the ink dries, leaving only the metal particles, an electrolyte and a moistening agent.

Other layers then can be applied directly over the first by the same method. Since no fusion process is used to integrate the metal particles, the layers will not short-circuit. Different metals are used in alternate layers. The finished layers, which can be printed on any non conducting surface—even paper, then are connected properly to yield a battery.

Shale Hole

➤ A METHOD of drilling a hole in shale for explosives involves heating the oil-bearing rock until it ignites, then blowing air into the hole. Enriched with oxygen, the air burns and permits the user to continue drilling the hole without the expense and bother of acetylene or other fuel gases and the fluxes they often require.

The highly fluid slag produced can be removed by the hot gases of combustion, or it can be quenched with water. This causes it to disintegrate immediately, or easily under mechanical pressure.

The process was invented by John W. Payne of Woodbury, N. J., who assigned patent No. 2,688,464 to Socony-Vacuum Oil Company, Inc.

Chemicals For Arid Land

➤ SOIL TREATING chemicals that even work on arid land have been patented.

Soils treated with alkyl benzene sulfonates soak up more rain, lessen the damage of flash floods, and yield their nutrients more easily to flowers, vegetables, shrubs and trees growing on them, reports Edgar W. Clarke of Laurel Springs, N. J. He assigned patent No. 2,689,173 to The Atlantic Refining Company.

In testing weak solutions of a C_{12} alkyl benzene sodium sulfonate, he found that a test strip of sun-scorched grass turned green for a week while adjacent strips, watered without the additive, stayed brown. The same chemical fortified flowering shrubs against frost, stimulated pear-tree growth to two inches in 48 hours, and produced four-inch iris blossoms on 36-inch stalks.

Paraffin Fuel

➤ A PARAFFIN hydrocarbon fuel for pulse jet engines won patent No. 2,688,840 for Robert M. Schirmer, Harold T. Quigg and Sylvester C. Britton of Bartlesville, Okla. They assigned the patent to Phillips Petroleum Company.

The fuel contains a mixture of paraffins that boil between 20 and 150 degrees Fahrenheit, and paraffins that boil between 150 and 500 degrees. In tests, the new fuel shortened starting time of pulse jet engines and did not harm the engines' valves.

The fuel ignites quickly, an important virtue for the pulse jet engine which may have as many as 400 separate combustions in a second. It burns with a high heat output and yields hefty thrust per fuel unit.

Pellet Desalts Sea Water

➤ A SEA water-desalting briquet for an aviator to use in a liferaft after ditching his plane over the ocean has been patented.

The briquet is dropped into a bag of sea water and is kneaded until all lumps are gone. After the chemical action is complete, the drinkable water can be filtered off to sustain the aviator until he is rescued.

The briquet is given a comparatively long storage life, particularly in hot climates, by compressing some of its chemicals into pills, or by coating them with gelatin or sugar. Calvin Calmon of Browns Mills, N. J., found that this stops interaction of the chemicals which often weaken the briquet's desalting strength. He assigned his patent, No. 2,689,829, to The Permutit Company.

Industrial Control Panel

➤ INDUSTRIAL designer Henry Dreyfuss of Pasadena, Calif., who planned the interior of the Perisphere and the American Telephone and Telegraph buildings at the New York World's Fair, has won a patent on an improved control panel for process industries.

The 50-year-old designer, who also created stage settings for "The Last Mile" and "The Cat and the Fiddle" during an 11-year theatrical career spanning the 20's and early 30's, has now designed an easy-to-understand control board for a plant operator to use.

A flow diagram is shown on the board and depicts graphically the process going on in the plant. Meters scattered appropriately through the flow diagram make it easy for the operator to see exactly how the manufacturing is progressing at various stages. Mr. Dreyfuss assigned patent No. 2,689,584 to Minneapolis-Honeywell Regulator Company, for whom he is a consultant.

Jet Engine Booster

➤ EXTRA SPURTS of power that may save a fighter pilot in combat are made possible by a device that boosts the thrust of turbojet engines.

According to patent No. 2,689,452, assigned to United Aircraft Corporation by Donald J. Jordan of Glastonbury, Conn., oxygen can be piped to the engine's combustion chamber or its afterburner. The extra oxygen increases the amount of fuel that can be burned, raising the power of the engine.

Book Condensations

THE STRUCTURAL CHEMISTRY OF PROTEINS—H. D. Springall—*Academic,* 376 p., illus., $6.80. Growing out of a course of lectures at the University of Manchester, England.

COLOR CHANGE IN OIL PAINTINGS—Robert L. Feller—*Mellon Institute,* 6 p., illus., paper, free upon request direct to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. Drawing attention to factors in color change which do not involve alteration of the pigments.

PROGRESS IN STEREOCHEMISTRY—W. Klyne, Ed.—*Academic,* 378 p., illus., $8.00. Discussing a few of the recent advances in this active field.

ORGANIC CHEMISTRY—Lewis F. Hatch—*McGraw-Hill,* 324 p., illus., $4.50. A text for a one semester course written primarily for those whose particular field of interest requires an understanding of organic chemistry.

MODERN CHEMICAL DISCOVERIES—Richard Clements—*Dutton,* 290 p., illus., $5.00. The author, both scientist and British science writer, has endeavoured to bring together in one volume all the chemical discoveries of the past fifty years.

MANUFACTURE AND APPLICATION OF LUBRICATING GREASES—C. J. Boner—*Reinhold,* 977 p., illus., $18.50. Describing the composition, properties and uses of lubricating greases.

HANDBOOK OF TEXTILE FIBERS—Milton Harris, Ed.—*Harris Research Laboratories,* 356 p., illus., $12.50. Bringing together for reference purposes a wealth of data on natural and artificial fibers, their physical and chemical characteristics as well as economic and manufacturing information.

SMALL-SCALE INORGANIC QUALITATIVE ANALYSIS—J. T. Stock and P. Heath—*Chemical Publishing Co.,* 96 p., illus., $2.50. The first American edition of a book originating in England. Practical aspects are emphasized throughout.

EXPERIMENTS WITH ATOMICS—Nelson F. Beeler and Franklyn M. Branley—*Crowell,* 160 p., illus., $2.50. You will not be able to make a toy atomic bomb at your kitchen sink with the help of this book, but you can produce illuminating models showing the structure of the atom and instruments used in its study.

RAPID DETECTION OF CATIONS—Gaston Charlot, Denise Bezier and Rolland Gauguin translated by Ralph E. Oesper—*Chemical Publishing Co.,* 92 p., illus., $3.00. Describing a method which can be applied to a single drop of solution.

THE MICROTOMIST'S FORMULARY AND GUIDE—Peter Gray—*Blakiston,* 794 p., illus., $10.50. Part I is a treatise on the art of making microscope slides from biological specimens and Part II is a classified list of the formulas and techniques used in that art.

QUALITATIVE ANALYSIS: Using Semimicro Methods—Esnarch S. Gilreath—*McGraw-Hill,* 287 p., illus., $4.25. A text for a one semester course answering the demand for a broader theoretical approach with less emphasis upon laboratory exercise.

THE CHEMISTRY OF PETROLEUM HYDROCARBONS: Volume I—Benjamin T. Brooks and others, Eds.—*Reinhold,* 664 p., illus., $18.00. An important reference work for chemists and petroleum engineers.

XUM

Proudly Presented

➤ PAPER from such synthetic fibers as Dacron and Orlon has been produced experimentally by the Du Pont Co. The new kinds of paper are said to have high strength, resistance to chemical attack, molds, bacteria and light, and to absorb little water. The company plans to supply the fibers and their experience in use of them in paper making to the paper industry. The announcement comes from Dr. Robert A. A. Hentschel of Du Pont's Pioneering Research Division, Textile Fibers Department, Wilmington 98, Del.

➤ SIZING AGENT for paper designed for dairy products containers, soap wrappers, boxboard and file card stock has been developed by Hercules Powder Co., Wilmington, Del. It is described as an alkylketene dimer, and has been trade-named "Aquapel."

➤ ADHESIVE substances to bond widely different materials in honeycomb structures for airplanes have been developed in two forms by North American Aviation, Inc., at Downey, Calif. Designated as Hi-Temp and CHT, their manufacture and marketing has been licensed to Rubber and Asbestos Corp. and American Latex Products Corp.

➤ DYNEL valve covers, which can be removed and laundered, will replace lead covers in the alkylation plant of California Oil Refining Co., which is located at Perth Amboy, N. J. Announcement comes from the Textile Fibers Dept. of Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y., who make the Dynel, versatile synthetic textile fiber.

➤ TWO NEW BOOKLETS describing chemicals available from the company are offered by Union Carbide through its Carbide and Carbon Chemicals Division, 30 E. 42nd St., New York 17, N. Y. Booklet F-8731 contains information on the properties of isopropanol and its many uses. Booklet F-4765, titled "Cellosolve and Carbitol Solvents," describes the nine commercial glycol ethers sold by the company.

➤ BOLTS which take advantage of titanium's strength to save weight in airplane construction are now manufactured for general use by Standard Pressed Steel Co., Jenkintown, Pa., under the trade name Hi-Ti. Alloyed with four percent each of aluminum and manganese, these bolts are said to have improved fatigue resistance over any made so far from the new, light, corrosion-resistant metal.

➤ MONSANTO Chemical Co.'s Organic Chemicals Division has issued a large wall chart showing more than 120 compounds made by ring substitutions, chloro reactions and nitro reactions from ortho-nitrochlorobenzene. For information about these chemicals write their public relations department at St. Louis 4, Mo.

➤ DOW-CORNING has developed a new adhesive, which has been named A-4000, for bonding silicone rubber to itself or to aluminum, magnesium, stainless steel, butyl or saran rubber. The material is available in pilot plant quantities, at a cost comparable to that of other silicone adhesives. Information for specific uses may be obtained from L. S. Putnam, Dow Corning Corp., Midland, Mich.

Science Exhibits

This year's combined end-of-the-year issue of CHEMISTRY

If you are planning an exhibit of your scientific project you will want the information and suggestions in this issue.

Science Exhibits tells you how to select your material, how to plan its presentation, how to display, to label and to light it, how to describe the work you have done, how to tell about it so that those who think science is "too difficult" will understand and share your enthusiasm.

Science Exhibits contains new samples of research project reports of the Science Talent Searches conducted annually by Science Service for the Westinghouse Science Scholarships. These reports have been selected by the Science Talent Search judging staff as outstanding for subject and method of presentation.

Science Exhibits describes the Science Youth Movement carried on by Science Clubs of America. This organization, comprising more than 15,000 Science Clubs in the high schools of the country, encourages young people's enjoyment of doing science projects, culminating in the local and National Science Fairs. This organization is *doing something* to ameliorate the shortage of young scientists, technicians and engineers.

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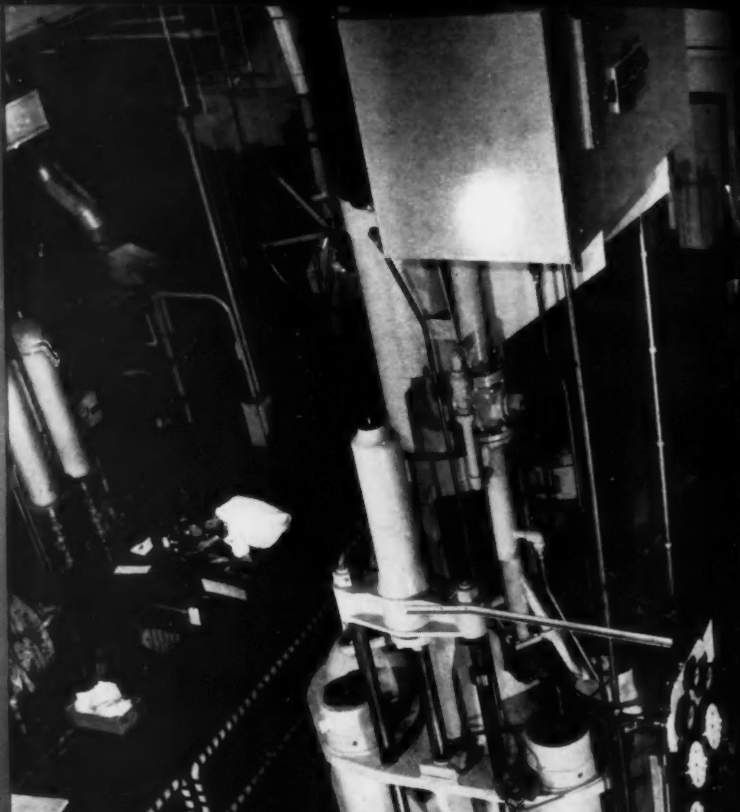

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